

Radio- Electronics

186-PAGE ISSUE

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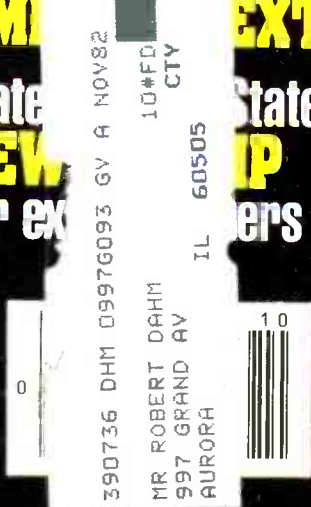
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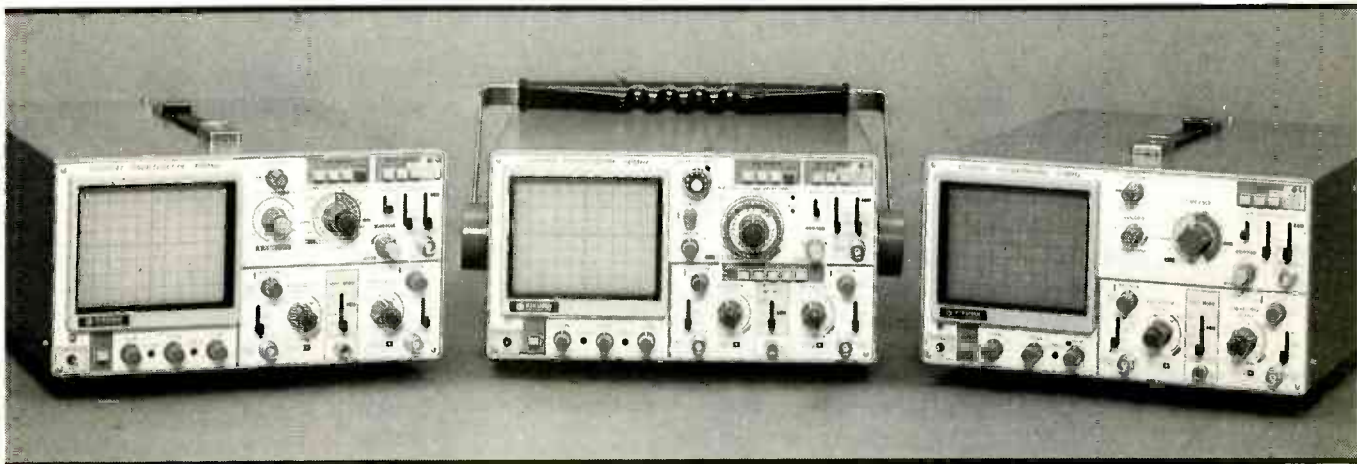
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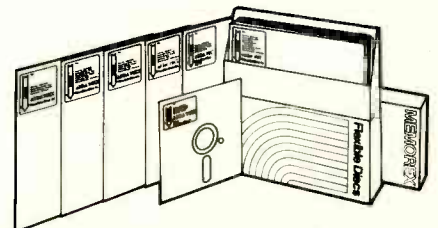
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SPECIAL FEATURE

- | | |
|-----|--|
| 43 | YOUR OWN COMPUTER: HARDWARE, Marc Stern |
| 45 | \$100-\$500 |
| 45 | \$2500-3000 |
| 53 | \$500-\$1000 |
| 53 | \$3000-\$3500 |
| 60 | \$1000-\$1500 |
| 60 | \$3500-\$4000 |
| 73 | \$1500-\$2000 |
| 73 | \$4000-\$4500 |
| 78 | \$2000-\$2500 |
| 78 | \$4500-\$6000 |
| 111 | 8 Bits vs. 16 Bits, Josef Bernard |
| | YOUR OWN COMPUTER: SOFTWARE, Herb Friedman |
| 113 | Games and Leisure Time |
| 122 | Software for the Home |
| 127 | Telecommunications |
| 131 | Dial-up Software Networks |

BUILD THIS

- | | |
|-----|---|
| 135 | PICTURE PHONE
Part 3. Winding up the theory and beginning construction.
Josef Bernard |
|-----|---|

TECHNOLOGY

- | | |
|-----|---|
| 4 | VIDEO ELECTRONICS
Tomorrow's news and technology in this quickly changing industry.
David Lachenbruch |
| 14 | SATELLITE TV NEWS
The latest happenings in communications technology.
Gary H. Arlen |
| 148 | STATE OF SOLID STATE
A low-distortion, high-output op-amp. Robert F. Scott |

CIRCUITS AND COMPONENTS

- | | |
|-----|---|
| 39 | BUBBLE MEMORIES
How those high-density storage devices work. Robert F. Scott |
| 143 | NEW IDEAS
DMM add-on. |
| 144 | HOBBY CORNER
Audio oscillator contest results Earl "Doc" Savage, K4SDS |

VIDEO

- | | |
|-----|---|
| 150 | SERVICE CLINIC
Derating components. Jack Darr |
| 152 | SERVICE QUESTIONS
R-E' Service Editor solves technicians' problems.
Jack Darr |

RADIO

- | | |
|-----|--|
| 146 | COMMUNICATIONS CORNER
Reading the mail. Herb Friedman |
|-----|--|

EQUIPMENT REPORTS

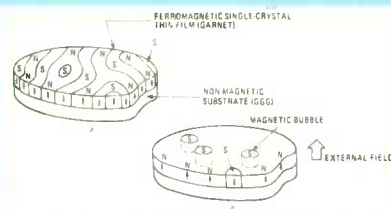
- | | |
|----|---|
| 28 | Weston 6500-series DMM's |
| 32 | Radio Shack Micronta Microwave-Leakage Detector |

DEPARTMENTS

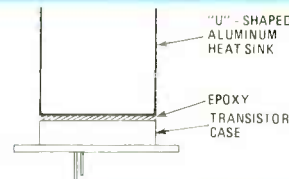
- | | | | |
|-----|-------------------------------|-----|---------------|
| 12 | Advertising and Sales Offices | 22 | Letters |
| 186 | Advertising Index | 160 | Market Center |
| 158 | Books | 152 | New Products |
| 12 | Editorial | 6 | What's News |
| 187 | Free Information Card | | |

ON THE COVER

Microcomputers—for the home and for business—come in all sizes and prices. You can pay as little as \$100 (or less!) or as much as \$6000 (or more). To help you make an intelligent choice in selecting a computer that meets both your needs and your budget, our Special Section, "Your Own Computer," groups computers and computer systems by price. Also included are descriptions of software and services that you may find useful. And, to round things out, there's a discussion of 8-bit vs. 16-bit computers. "Your Own Computer" starts on page 43.



BUBBLE MEMORIES combine the read/write features of RAM with the non-volatility of ROM, and approach tape and disk systems in storage capacity. Find out how they work and how they're used starting on page 39.



DERATING CIRCUIT-COMPONENTS can extend their life and make the equipment in which they're used more reliable. This month's Service Clinic covers that topic, beginning on page 150.

Due to lack of space we are unable to include Part 2 of the "Heart-a-Matic" in this issue. It will appear next month.

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VIDEO ELECTRONICS

DAVID LACHENBRUCH
CONTRIBUTING EDITOR



COMPO BOXSCORE

As I've been predicting the last few months, this is the year for introduction of component TV. This fall, nearly a dozen brand names are planning to get into the act—not all of them traditional TV makers, by any means. Hi-fi manufacturers are going video, following the lead of Fisher, and most of them are choosing the component approach, naturally enough. Even such relatively small firms as NAD and Proton are planning video-component outfits, both built around the same 19-inch color monitor, the former to sell it through audio dealers, the latter at department stores. Jensen, see photo, is entering video in a big way, with both 19- and 25-inch monitors, a TV-FM-AM receiver accessory, and one without AM-FM. Pioneer also has two screen sizes, and claims that its 25-inch monitor has 400 lines of horizontal resolution, the highest promised by any manufacturer. NEC, known in this country primarily as a manufacturer of professional video, has color monitors in five screen sizes, along with all associated components. Among traditional TV manufacturers, you'll find Mitsubishi, Panasonic, Sanyo, Teknika, Zenith and, of course, Sony represented in the component sweepstakes.

There's no agreement on what each video component should include, so there's a wide difference in products. In most cases, the remote-control tuner is combined with a switcher as a "tuner-controller," but some offer them separately. Monitors can include: (1) No audio. (2) Mono amplifier and speaker. (3) Mono amplifier and no speaker. (4) Stereo amplifier and no speakers. (5) Stereo amplifier and one speaker. (6) Stereo amplifier and two speakers. All, of course, have output jacks for separate audio systems.

Some manufacturers have chosen not to go all the way to components, but to offer products which can be used either as components or complete sets. RCA highlights that group, with its SelectaVision line of "monitor-receivers," highlighted by a 25-inch table model which seems to be all screen and is smaller than many 19-inch sets. It contains side-firing stereo speakers, a tuning panel just above the picture tube (and by infrared remote), and a group of video and audio input and output jacks. The remote-control unit activates switching among inputs.

MINI-VHS

"VHS-C" (the "C" stands for compact) is the new name for the controversial mini-VHS videocassette system, scheduled for marketing here this fall by JVC and Sharp, and later perhaps by others in the VHS group. Developed by JVC and embraced in Japan by all VHS manufacturers, the system uses a small cassette of 1/2-inch tape not much bigger than a cigaret pack, which can be played back through any VHS recorder by using an adaptor that lets it fit in the cassette compartment.

The idea behind all that, of course, is portability—and JVC's VHS-C recorder weighs just 4.4 pounds and measures a little over 7 × 3 × 8.5 inches. The single-speed portable will sell for about \$700 here and record for up to 20 minutes on a miniaturized cassette, available for about \$10. The adaptor—only one is needed to play compact cassettes in a standard VHS recorder—will be around \$20. Other VHS recorder suppliers are nervous about introducing the system in the United States, because the recorder must be priced very close to the tag on a full-featured standard VHS portable, and because a new miniature-cassette standard for portables is scheduled to be developed for sale in 1984 or 1985. So they're going to watch and wait—and if the JVC and Sharp minis hit market gold, the others are sure to come in quickly with their own brands.

R-E

THE CASE FOR THE TRAVELING TEST LAB

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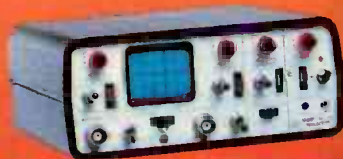
A pre-scaler to take the FM-7 out to 512 MHz (SC-5) or

A basic 4 digit multimeter (LM4A) or

The new NLS Tracer (TR-1B), a revolutionary signature analyzer for troubleshooting in or out of circuit with no power applied to the circuit.



TT-20B



MS-215

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WHAT'S NEWS

IBM introduces new videotex for business

The Series/1 Videotex System (SVS/1) just announced by IBM, is a licensed program that enables organizations to establish private videotex systems to send and receive text and graphics. It uses standard telephone lines to link IBM Personal computers, low-cost videotex terminals, or television monitors equipped with special adapters to data contained in an IBM Series/1 general-purpose computer.

The system is similar in function to British Telecom's *Prestel* system, but includes a number of additional features. It uses an alphamosaic pattern (one in which graphic images are built up of a "mosaic" of small rectangular elements) to create videotex images.

The SVS/1 system can store up to about 350,000 frames of information—each frame consisting of 24 rows and up to 40 characters per row—combining text and graphics in up to 8 colors. It can respond to up to 24 concurrent callers, or a larger number of intermittent ones.

SVS/1 provides a fast, efficient vehicle for businesses to communicate timely information to their employees at either central sites or remote offices. It can transmit such material as internal mail, budgets, merchandising informa-

tion, travel schedules, and bulletin-board notices, to name a few of its possibilities.

The system provides up to 99 levels of security to protect sensitive information. It checks the security level of each frame automatically before displaying it.

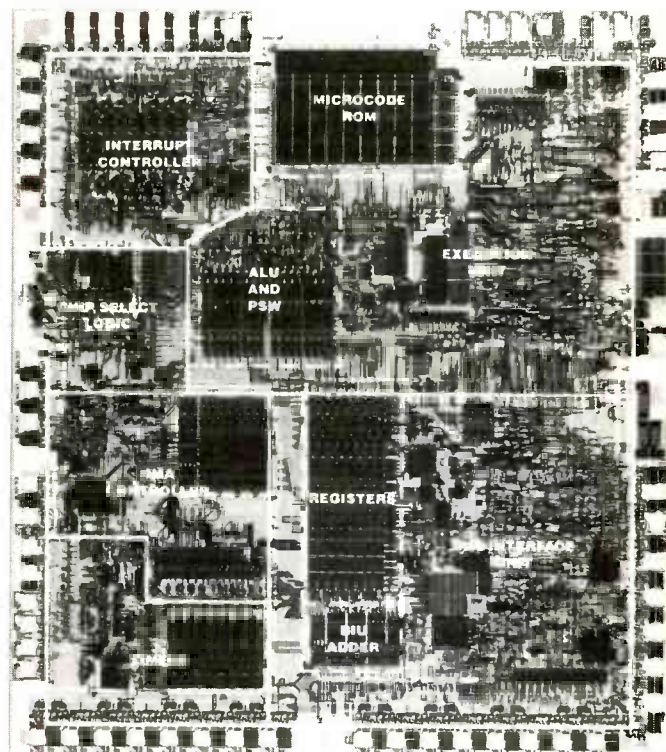
First customer shipments of the SVS/1 were scheduled for December 1982. The program has a one-time license fee of \$10,000.

Cable company offers wide range of services

Owners of multiple-dwelling complexes are offered a combination of satellite-TV reception and a customized videotape viewing service by a Michigan cable company, DBC of Brighton. The cluster living-complex owner is provided with a commercial dish antenna, a UHF-VHF master antenna, suitable head-end amplifiers, and a videotape player.

The equipment will make it possible to bring in up to eight local off-the-air television channels, and up to six satellite-delivered channels. In addition, equipment and a customized videotape viewing package that can be matched to the needs of the viewers is provided. DBC is emphasizing family-oriented films, and other kinds of family entertainment. The tape program will be updated regularly.

Availability of good TV and



FUNCTION PLACEMENT on the Intel 80186 chip.

videotape programs is not the only advantage of a cluster-complex owner, DBC president Jim Cassily points out: "The very presence of a satellite antenna can attract potential tenants to a living complex. Recent surveys of hotel and motel owners show a significant increase in occupancy rates directly attributable to the installation of a satellite antenna system, in direct view of motorists driving by."

CPU "board on a chip" replaces 15-20 IC's

Intel Corp of Santa Clara, CA. is now sampling its new iAPX CPU (80186), a single chip that contains a 16-bit CPU plus all the other functions commonly found in a single-board CPU subsystem. The 80186, says Intel, can take the place of 15 to 20 individual IC's and thus offer a lower-cost and higher-performance solution for such cost-sensitive devices as personal computers, word processors, small business computers and intelligent terminals.

The 80186 is housed in a 68-pin,

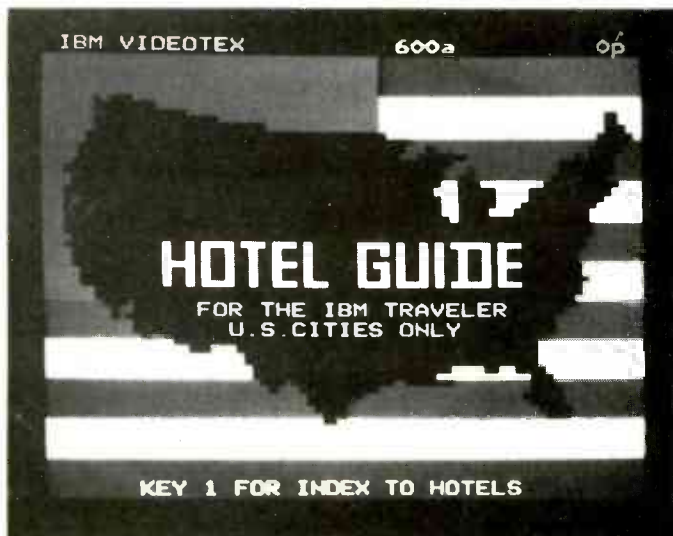
leadless Jeduc type-A hermetic chip carrier. It requires a 5-volt-only power supply. The introductory price is \$50 each in quantities of 100. Production quantities are scheduled for the first quarter of 1983. It is expected that the price will drop below \$30 in the first year of production.

Future electric auto to operate on AC?

The Research and Development Center of General Electric is now working on \$3.1 million sub-contract from Ford for research and development of a power train for electric vehicles. The research is aimed at developing a system that uses an AC motor instead of the DC type normally associated with electric cars.

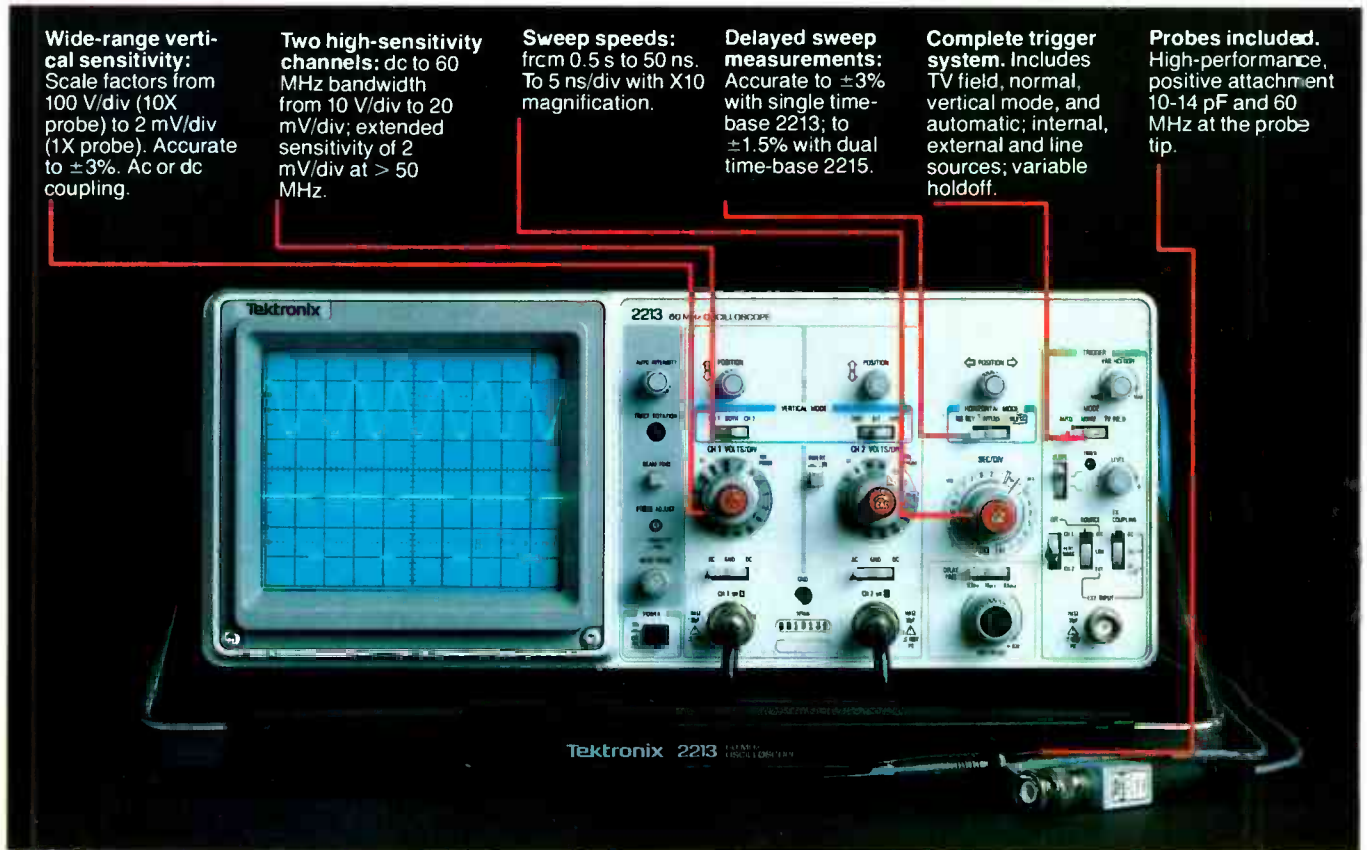
The power train will include the AC induction motor and an automatic transaxle (transmission and gears) integrated in a common housing on the front wheel axis. A common oil system will both lubricate and cool the equipment. An

continued on page 10



TYPICAL DISPLAY from IBM's new videotex system.

Now! A 60 MHz Tektronix scope built for your bench.



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You can order, or obtain more information, through the Tektronix National Marketing Center, where technical personnel can answer your questions and expedite delivery. Your direct order includes

probes, operating manuals, 15-day return policy and full Tektronix warranty.

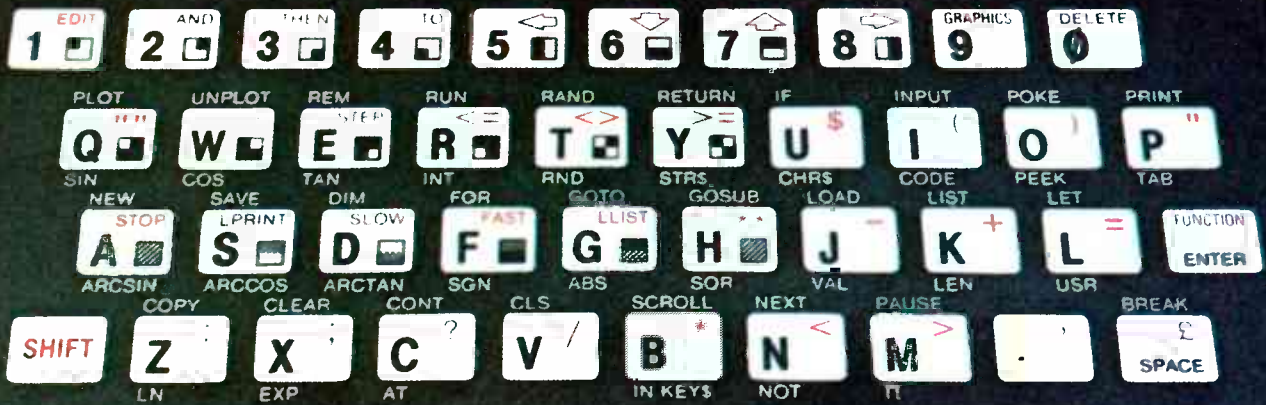
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 - Automatic syntax error detection and easy editing
 - Randomize function
- useful for both games and serious applications
- 1K of memory expandable to 16K
 - A comprehensive programming guide and operating manual

The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. It comes with a comprehensive programming guide and operating manual designed for both beginners and experienced computer users. And you can use a regular cassette recorder to store and recall programs by name.

Sinclair technology is also available in Timex/Sinclair computers under a license from Sinclair Research Ltd.

Order at no risk.**

We'll give you 10 days to try out the ZX81. If you're not completely satisfied, just return it to Sinclair Research and we'll give you a full refund.

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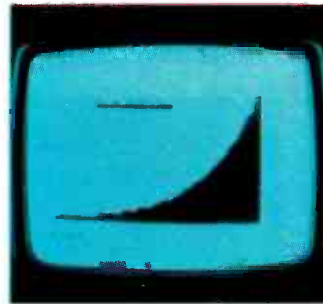
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WHAT'S NEWS

continued from page 6

advanced high-power, light-weight and compact inverter will convert the DC energy from the batteries to AC.

The high cost of such an inverter has long been a stumbling block in the way of using the many advantages of AC motors in electric vehicles. GE believes it can use its experience in high-powered transistors and integrated circuits to overcome the cost obstacle.

Ford, the prime contractor under a program of the U.S. Department of Energy, will manage the overall program, as well as design the power train, transaxle, and the microprocessor-based vehicle control system. GE will design and build the motor, the transistorized power inverter and the drive control (the electronic package that controls the motor and inverter.)

The program calls for delivery of two experimental power trains to DOE/NASA in the spring of 1985. One will be installed in a Ford Escort for road test—the other used for bench tests at NASA's Lewis Research Center.

New discmaking process developed by Philips

A completely new technique for mass-producing video recording discs is now being used by the Philips LaserVision system, in its videodisc factory in Blackburn, England. A liquid organic lacquer is poured into a mold that contains the video and audio information in the form of small projections on a disc face. It is then exposed to light and the lacquer hardens, with the audio and video information transferred to it in the form of small pits. The "photopolymerization" (2P) process was devised at Philips Research labs in Eindhoven (Netherlands).

Special efforts were necessary to adapt the new technique to mass production. Production molds are made in a number of steps from a master disc, much as in earlier forms of disc record manufacture. A few milliliters of the 2P lacquer is poured into the center of the production mold. A transparent plastic disc (the substrate of the video disc) is placed on it. It is then pressed flat against the production mold, spreading the layer in a thin fluid coating that lies between the



MANUFACTURE OF LASERVISION VIDEO DISCS in the Blackburn (U.K.) factory.

substrate and the mold.

The lacquer is then exposed—through the plastic substrate—to ultraviolet light, which polymerizes (hardens) it. A reflective aluminum layer is evaporated on the layer of lacquer, and a protective layer placed on top of that. Then the protective layers of two discs are bonded together. That produces a double-sided disc, playable through and protected by the transparent plastic substrates.

U.S. AM stations are moving fast into stereo

Following the FCC's decision not to select and approve any one of the proposed AM stereo broadcast systems, but to let the public decide which is best through open competition, at least five systems (none of which is compatible with any of the others) are competing. The results may be interesting.

One result that is already apparent is that the broadcasters are ready for the new development. One equipment manufacturer, Harris Corp of Quincy, IL, reports over 100 firm orders for stereo

broadcast equipment by last April 7. Nearly half of them were picked up during the four days of the National Association of Broadcasters convention and show in Dallas April 4 to 7.

Three computer firms adopt joint standards

Standards for the creation and transmission of computer graphics have been jointly approved and adopted by Digital Equipment Corp, Intel Corp, and Tektronix Inc. The companies plan to incorporate the standards into their future products.

The standards agreed on are in the field of computer-graphics images. The first of the two proposed standards is the North American Presentation Level Protocol Syntax (NAPLPS). It is a communications protocol to be used in transmitting graphics information.

The second proposed standard is the Virtual Device Interface (VDI). It provides standardized access to graphics/functions that can result in improved software portability among computer sys-

tems and graphics devices.

CBS/Columbia forms video games unit

Following a recent agreement between CBS and the Bally Mfg. Corp., CBS is launching CBS Video Games, as a division of its toy and games subsidiary, Gabriel Industries.

The agreement gives CBS the home videogame and computer rights to games that Bally now has in development, as well as games to be developed or licensed during the next four years. CBS plans to introduce its first package of three or more games—all compatible with the Atari Computer System—by the end of 1982. The new division also expects to market games for the Mattel Intellivision.

Galvin urges "response" to Japan trade policy

Robert W. Galvin, Chairman and Chief Executive Officer of Motorola, told more than 200 electronics leaders that American industry faces a dual challenge from Japan: its ability to dominate certain industries worldwide, and a concerted national program to protect and promote certain industries so that they can achieve such domination.

Speaking before the 7th annual Hyannis Conference of the Electronic Industries Association (EIA) Communications Division, he said the United States should not accept national industrial policies that enable any other country to assume a dominant position in the U.S. market, and called upon the government to identify U.S. industries now being targeted by Japanese industrial policy. The government, he stated, should "take any necessary steps to ensure that U.S. industries are not placed at a disadvantage in competing with Japanese firms."

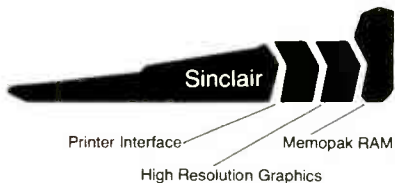
Citing examples of anti-competitive behavior, Galvin said the government must:

1. make targeting by foreign industrial policies grounds for trade relief;
2. set market-share ceilings for countries engaged in such targeting;



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EDITORIAL

Not *Another* Buyers Guide To Computers!

I don't consider myself to be an "oldtimer", but I do remember the beginning of the "personal computer" revolution. In the beginning, there was the July 1974 issue of **Radio-Electronics** that carried the first published construction article for a personal computer built around a microprocessor—the *Mark 8*. That article created quite a stir among our readers. Not long afterwards, several companies (actually, they were "garage" operations) started introducing commercially available computers. Most notable were MITS, Imsai, and Processor Technology.

The only method for storing programs in those days was to use an audio cassette-tape recorder. The bootstrap loader, the program that transferred the "operating system" from the tape to the computer, had to be loaded manually using front-panel toggle switches. I remember seeing a demonstration of the MITS Altair and watching the demonstrator's fingers whiz over those toggle switches with lightning speed as he entered the bootstrap program.

Computers have come a long way since then. Today, you can easily spend over \$10,000 for a personal computer or as little as \$79.95. You buy from small companies or from large companies. And, just when you feel that the market has reached saturation and can't support another computer, another one is introduced.

In confirmation of the vast number of computers that are available, this month's buyers guide contains 96 pages. We put that section together because we feel that if you are considering purchasing a personal computer, and in our reader surveys you tell us that you are, then it's imperative that you know what's available before you make a decision. That applies not only to the hardware, but to the software as well. That is why our buyers guide also includes a comprehensive software section as well.

We *did* raise the cover price for this issue, but fear not: that price will be in effect for only this issue. Also, we do not *not* intend to become a computer magazine. **Radio-Electronics** remains dedicated to the broad coverage of the entire electronics industry.



ART KLEIMAN
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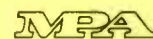
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SATELLITE/TELETEXT NEWS

GARY ARLEN
CONTRIBUTING EDITOR

NATIONAL TELETEXT

NBC and CBS will launch national teletext services, possibly as early as this autumn. The start of the services will depend on "satisfactory completion" of the teletext rules being considered at the FCC and on other business factors, such as availability of TV sets that can pick up teletext signals. Technically, both networks will use the North American Broadcast Teletext Standard, a hybrid format based on the French Antiope system.

At the same time that the networks announced their teletext transmission plans, NBC's parent company (RCA) revealed its endorsement of the NABTS and indicated that its TV-set manufacturing division would be building receivers in that format during the coming year. RCA, the largest U.S. TV-set maker, urged early adoption of the standard as the single U.S. technical format.

For the national network service, both networks will develop teletext magazines based on their experiences during teletext tests on the stations that both companies own in Los Angeles; the year-long trials there included news, sports, and travel and business information, along with games, feature information, and advertising. For the national network service, CBS also plans to offer closed-captioning of some prime-time shows. Affiliates will be encouraged to develop local teletext inserts (ads and information) as page-creation equipment and home decoders become available. NBC's service will initially be broadcast by the five stations which the network owns (New York, Los Angeles, Chicago, Washington, and Cleveland) and by affiliates which want to take part.

The CBS and NBC plans may be the initiative to start teletext momentum, thus encouraging other set-makers to begin building teletext receivers. ABC has stayed away from teletext technology altogether, and PBS has been involved with a number of local teletext projects, although financial difficulties in the public-broadcasting world probably means that there will be little action from that area in the near future.

DIRECT BROADCAST SATELLITES

Direct Broadcast Satellite service could become available by 1986, thanks to an FCC ruling that cleared the way for DBS operators to plow into their plans. The FCC action put the official stamp of approval on an earlier Commission ruling that had permitted nine companies with DBS plans to proceed with their efforts.

The latest FCC action is still subject to revision at the 1983 Regional Administrative Radio Conference, which will plan the orbit and frequency allocations for DBS in the western hemisphere. The Commission's ruling on DBS was considered a landmark, however, because it clearly identified satellite TV as a "broadcast" service, yet one which is not subject to traditional broadcast requirements such as programming to meet local community needs.

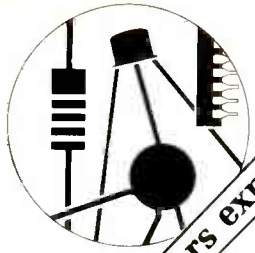
Administratively, the FCC ruling allocated 500 MHz of spectrum in the 12-GHz band for downlinks and 500 MHz of spectrum in the 17-GHz band for uplinks. The FCC declined to impose technical standards beyond those required by international agreements, and adopted a flexible regulatory approach that will avoid delay in the introduction of DBS and which will allow DBS operators to determine the characteristics of their services. There is no requirement that high-definition TV or other enhanced services be included in DBS services—although several applicants (including CBS) plan to offer HDTV.

GOING UP FROM NEW YORK

Home Box Office is building a new satellite uplink center in suburban New York. The center, which will cost as much as \$20 million, will replace HBO's current uplink in Vernon Valley, NJ, which it leases from RCA. The new Hauppauge, Long Island, center will initially be equipped with four 11-meter uplink antennas—the start of an impressive antenna farm.

At about the same time that HBO announced its uplink plans, another antenna farm in the New York area was unveiled. The Port Authority of New York and New Jersey, in partnership with Merrill Lynch & Co., revealed plans to build *Teleport*, a \$300 million satellite communications center and office complex on Staten Island, with up to 17 earth stations. Business data communications are atop the list of activities, although teleconferences and broadcast/cable video transmission are also expected to be beamed through the Teleport facilities, which will include fiber-optic connections. The Staten Island site was selected because, although part of New York City, it is just far enough away from the center of town to avoid the microwave congestion which clogs and interferes with signals in the crowded Manhattan business district.

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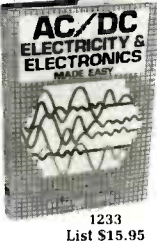
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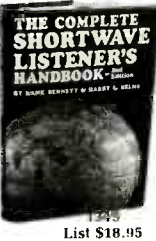
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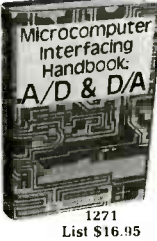
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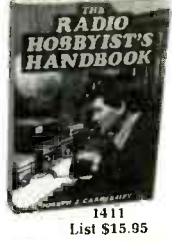
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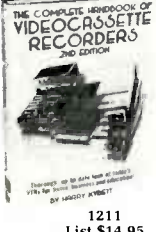
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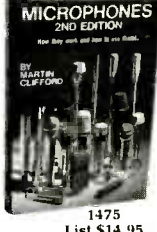
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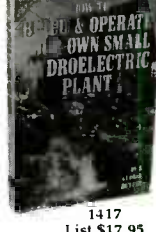
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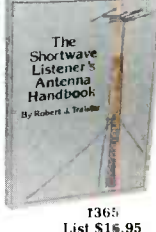
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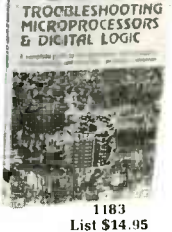
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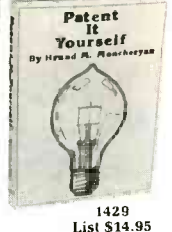
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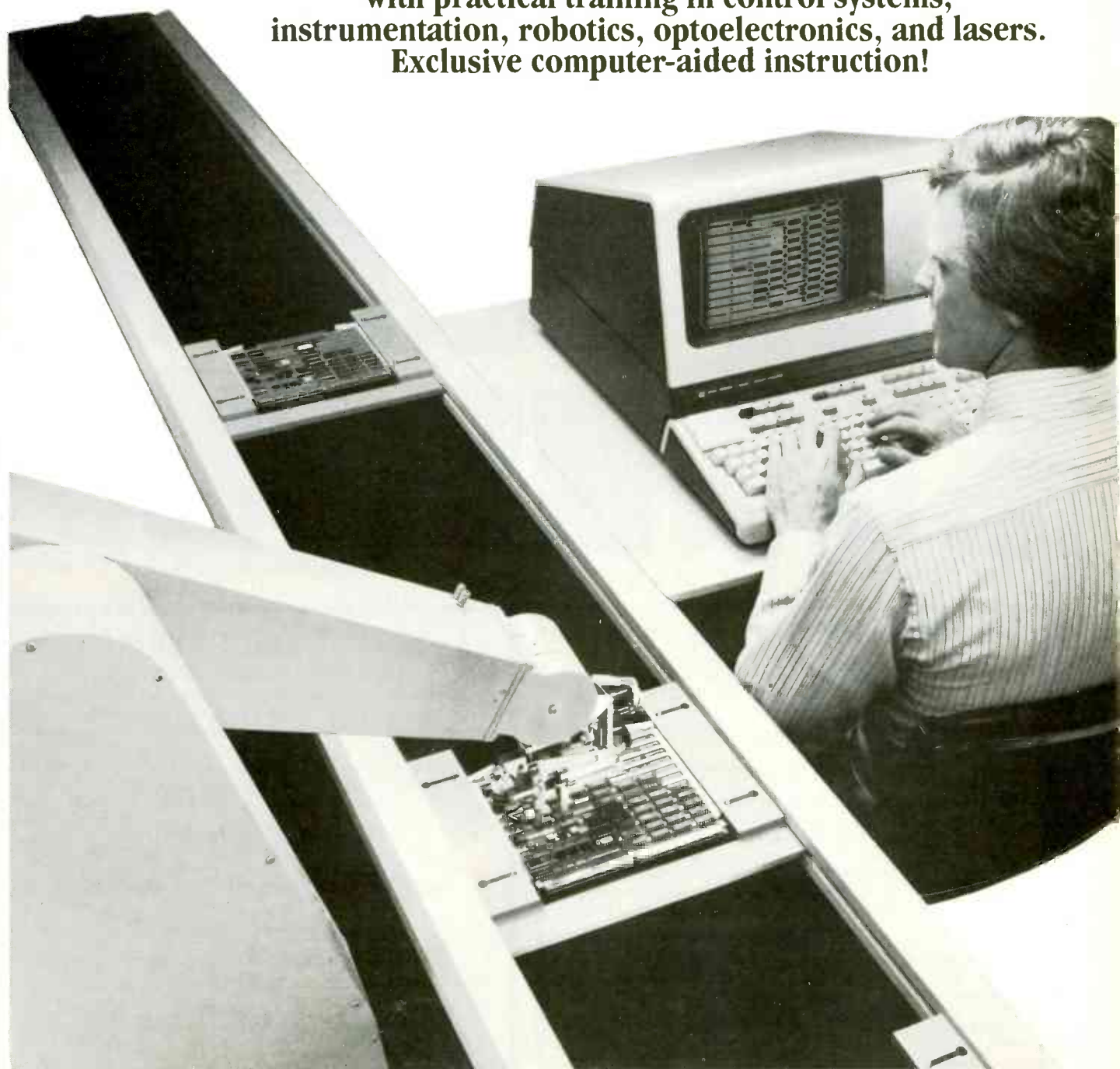
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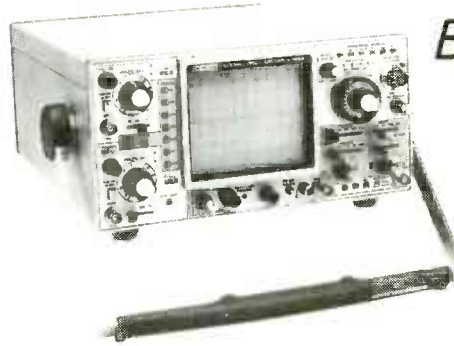
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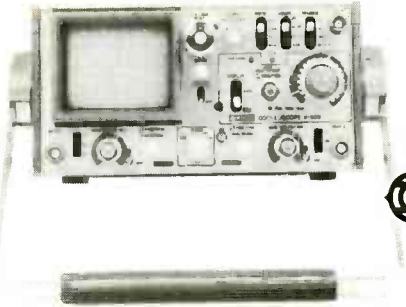
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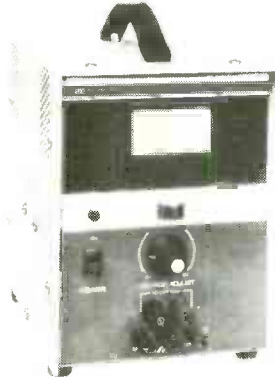


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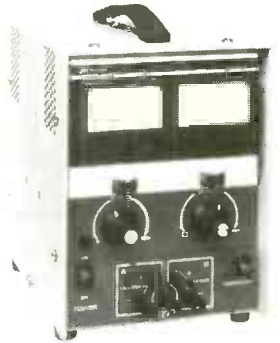
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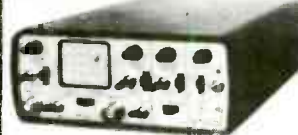
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PC BOARDS

It is difficult for me to express fully my appreciation for your magazine. As an enthusiastic electronics hobbyist for many years, I have always enjoyed your fine articles, departments, and projects. Every copy is a treasure, full of information; I can't remember ever picking up an issue without finding at least one project I wanted to build.

What I am really looking forward to is an article on making your own PC boards, photographically, from the foil patterns you usually provide. I have tried to do so many times, but because of limited equipment and "know-how," the results have usually been less than adequate. Since the materials and chemicals used in that process are quite expensive, mistakes are usually costly and time-consuming, not to mention frustrating. I'm sure that I speak for many other readers when I say that such an article, or series of

articles, on the subject would be welcomed with open arms!

P. CONSTAN
East Islip, LI

Please stay tuned! Just such an article will be appearing in the very near future.—Editor

OUT OF PRINT

First, I want to thank you for the review of *Buyer's Guide to Video Cassette Recorders* that appeared in your May 1982 issue.

Now it is my sad duty to inform you that this book has been out of print for some time, and the review has created problems for us. We are getting numerous requests for it, as a result of the Free Information Card that appeared in your magazine. I only wish I had the time to answer every request for the book; but as I do not, I would only ask that you notify

your readers of the circumstances: *Buyer's Guide to Video Cassette Recorders* is out of print.

MARTIN L. SCHAMUS,
Sterling Publishing Co., Inc.

VIDEO CASSETTE RECORDERS

I have been thinking about video cassette recorders and the fact that government officials want them outlawed. I am for those little VCR's, and I can't see why there should be such a fuss over them. I think that they are legal, and I have a bit of information to back that opinion up.

Every American citizen is constitutionally guaranteed the right to record signals from TV sets. Section 47 of the Communications Act of 1934 states that an American citizen has the right to receive any transmission from any source. In my opinion, that must include

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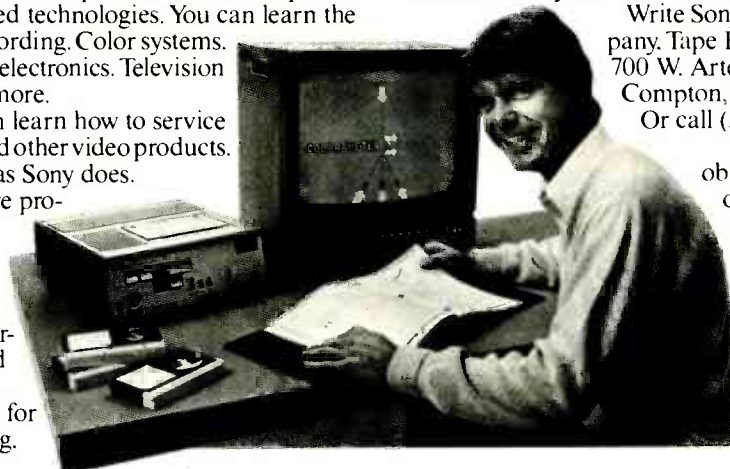
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the right to record signals from TV sets. Those rights have been tested by the Superior Court of the District of Columbia, and have been upheld under the First, Fourth, Fifth, Ninth, and Tenth Amendments.

People record signals from radios every day, and the government doesn't say anything about that. So, until they change it in the courts (if they do) everyone should be entitled to use video cassette recorders.

PAUL L. GRAY, JR.
Colorado Springs, CO

RADAR DETECTORS

Being trained as a physicist, and having been employed for the Department of Defense since 1962, I have amassed more than

a little knowledge and experience with Doppler Radar. I have been amused at several of the letters concerning traffic radar, especially since I was cited in Kansas near Emporia for driving at 78 mph in a 1973 Vega SW with two cylinders operating so inefficiently that its maximum speed was 54 mph on flat highway.

I was particularly interested in the letter from Mr. Richard Kolasinski (**Radio-Electronics**, August 1982), who says "...but I have yet to hear of a radar-detector in car being used for any *other* purpose except to avoid getting caught when speeding." I must inform Mr. Kolasinski that it is common practice for amateurs operating two-meter transceivers, and knowledgeable Citizen Radio Services operators (11 meters) to operate radar-warning receivers (RWR) to inform them that it is unwise to transmit at a

specific time while they are being "painted" by Doppler Radar, even though they are not speeding. That is to avoid getting caught when *not* speeding, as it has been shown numerous times that such transmission will heterodyne with the traffic-radar carrier frequency in the K-band (10.5 - 10.55 GHz).

He should also be advised that Mr. Rod Dornisfe, a former San Diego police officer, testified in court at Burlington, KY on January 17, 1980, that radar equipment and radar operators have a 30% error rate (also known as false-alarm rate) on a nationwide basis. He should also be advised that Dade County Judge Alfred F. Nesbitt was cited for driving at 63 mph during the weekend of July 4, 1982, even though his cruise control was set at 55 mph, and it was his first citation in 45 years of driving. Judge Nesbitt convened a court hearing after he learned that Florida police had clocked a speeding banyan tree and a house moving at 28 mph during 1979. Obvious the actual target and the intended target were not identical, and that problem is one of the deficiencies of traffic radar systems. Judge Nesbitt's hearing did, in fact, document other instances of the radar system's fallibility. Eighty cases based upon radar evidence were then dismissed, and Dade County police are now required to support an arrest with evidence obtained through pacing.

If anyone does a large amount of traveling via the automobile, it would be prudent to equip his or her car with cruise control and an RWR of the superheterodyne type for self-defense.

One might well ask, with respect to the "moving" tree or house, just what *did* the radar system measure? First of all, it must have been a strong reflector of K-band frequencies, such as a metallic surface. Next, Doppler systems require that the radar return be different from the transmitted carrier by an amount equivalent to an audio frequency. The calibration test consists of a tuning fork oscillating at a frequency usually corresponding to 60 mph, and the vibration must be in the direction of the beam. A road sign vibrating about a vertical axis in a strong wind also provides a good radar return, as does an electrical transmission line suspended above the roadway, or a nearby windmill rotating in the wind and also in the radar beam.

It is possible that any one of those reflectors were in the beam directed at the house or the tree by the police operator. However, since the operator's mind has isolated the target, more often than not, that is all that he considers as a potential target. Thus, the guilt oftentimes cannot be validated "beyond reasonable doubt" since his eye cannot corroborate the intended target as the actual target. Even if there is only a single vehicle within a reasonable distance of, or inside, the radar beam, a transmission of a suitable radio frequency has been shown to cause a false measurement and the interference is unseen by the operator.

There are far too many circumstances for even a very accurate system to fail to provide a true measurement, let alone the traffic-radar systems now on the market and in actual use. A traffic-radar system could be built that would function with as little as a 5% false-alarm rate, but such systems would be orders of magnitude more expensive than current systems, and still might not provide evidence "beyond a reasonable doubt" in all courts of law.

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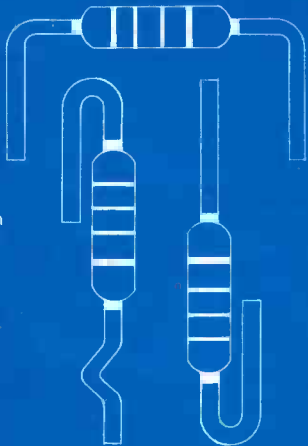
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In the defense of my innocence after my citation in 1977, I qualified myself as an expert witness and the prosecution acquired the services of the gentleman who designed the radar system which provided the evidence against me, the Kustom Signal, Inc. MR-11.

I testified to all of the above circumstances as being possible, provided a mechanic's data as to the condition of the engine in my vehicle, and prompted my attorney in his eliciting testimony from the arresting Kansas State Trooper. What came out was that every time the Trooper drove past a particular place on a highway, the radar indicated 88 mph even when his was the only vehicle within seven or eight miles. I, myself, have heard sophisticated RWR's sound off and give a visual indication of an RF field in the K-band capture band with no other vehicles in sight. The RF energy is there, but it does not emanate from traffic radar.

How could one defend himself in court without knowing that he had been "painted" and taken pains to record and verify his vehicle's speed? Possibly Mr. Kolasinski would conclude that the driver is guilty, regardless of the circumstances, simply because the radar measured a number. At any rate, the designer of the MR-11 told me later that this was the first case of the many that he had had, that he had lost! I wonder why.

J. FRANK FIELDS
Lawrence, KS

ENERGY MISER

In your article entitled "Energy Miser for Your Furnace," **Radio-Electronics**, August 1982, the equation for the temperature conversion is not printed correctly. It should read: Temp (in °F) = 1.8 × Temp (°K) - 459.67

The factor 1.8 is equal to the usual conversion factor of 9/5, as everybody knows. But, without the factor in the equation, there may be misunderstanding in the text.

In the description that follows the equation, the text mentioned R1 and R2 for water-temperature sensor, IC6. As far as the circuit diagram is concerned, R1 and R2 are in the air-temperature sensor IC5 circuit. You see, there is also a little mix-up here.

H. HSU
Professor, Department of Engineering,
Ohio State University

R-E

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BACK IN THE 1930'S, IF YOU OWNED A Weston meter you were considered one of the elite in the field. A lot of things have changed since then, but at least on thing has stayed the same—Weston (614 Fre-

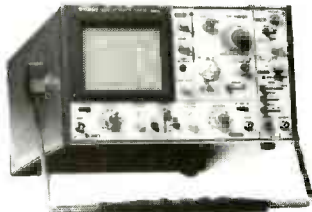
linghuysen Ave., Newark, NJ 07114) is still turning out some of the finest test instruments on the market. One of their latest is actually a series of high quality DMM's. There are two basic meters in

this series. They are pretty much identical, except that one, the *model 6502*, measures average AC, while the other, the *model 6504*, measures true RMS.

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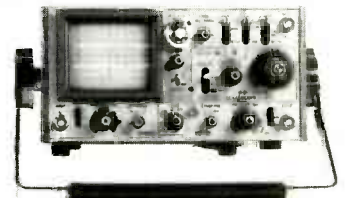


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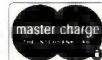
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PLEASE RUSH ME THE 1982 REPLACEMENT MASTER GUIDE.

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CIRCLE 12 ON FREE INFORMATION CARD

Range selection and the standard DMM functions are controlled by a row of paddle-like switches at the bottom of the front panel. So far that sounds like an ordinary DMM—but wait, there's more. This DMM has a microprocessor.

The microprocessor is used for several special-function modes, all of which are controlled by two rows of front-panel pushbuttons. These pushbuttons are also used for entering data as needed in the special-function modes.

The Filter mode inserts a special averaging-value filter for reading noisy inputs.

The Scale/Offset mode does just what the name implies—it will scale the reading by a pre-entered amount A, and offset it by a pre-entered constant B. That is useful for such things as measuring the output of a transducer or other type of sensor, eliminating the need for extra calculations.

The Percent-Deviation mode displays the percent difference between what is measured and a pre-entered constant N.

The Null mode is used to subtract the initial reading from all subsequent readings. Among the uses for this is to null out the resistance of the test leads—that becomes critical when you are working with very low resistances.

When the unit is in the Hi/Lo Limit mode, the measured value is compared to pre-entered limits stored in the Hi and Lo

registers. If the value is higher than the limit stored in the Hi register, the readout will simply display a HI message; if it is lower than the value in the Lo register, the readout will display a LO message. If the measurement falls between the two limits, the measurement is displayed as usual.

The Min/Max mode is similar. Here, however, the maximum and minimum values of a series of measurements are stored in registers. Pressing the MAX button recalls the maximum value; pressing the MIN button recalls the minimum value.

Note that more than one of the meter's special modes can be used at one time. In fact, all of them could be used together if desired. When more than one function is in use, the order of execution is Filter, Null, Scale/Offset, Percent Deviation, Max/Min, and Hi/Lo Limit.

The panel is clearly marked in white and yellow. Lines and arrows tell you which buttons are used together. White markings are used to identify the special-function modes and the registers. The yellow markings are used for data-entry functions. That is important, since most of the buttons are used for more than one purpose, very much like what is done in advanced pocket-calculators. The instruction manual gives a very clear and thorough explanation of just exactly how to set up and use each of the special-

function modes. From experience, I can assure you that it pays to read the book carefully first!

The 4½-digit LCD display used also provides annunciators that are used to identify which of the special function modes are in use. Also, the readout will display several prompts, in English, to help you along. For instance, when you turn on the instrument, a FUNC prompt will appear on the display. That prompt requests that you enter one of the standard functions such as AC VOLTS. Once that is done, a RNG prompt asks you to enter the range desired. If a measurement exceeds the entered range, an O.RNG (overrange) prompt will appear. If the input exceeds the maximum voltage limits we mentioned earlier, an OUCH prompt appears; that one is my personal favorite!

The instruction manual is quite good. It tells you just what the instrument can do, how it does it, and, most important, how you can get it to perform properly. Read it carefully. It includes a full circuit description, schematics, calibration data, and a full parts list. It gives examples of how to set up each of the special-function modes.

Six special probes are available for use with these meters. One is an AC clamp-on probe for reading AC currents up to 200 amps. Another is a temperature probe that will read temperature directly, in either °F or °C. A switch is used to select the desired scale. A "hold" probe allows you to



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William Stone,
Technical Manager, ABC-TV

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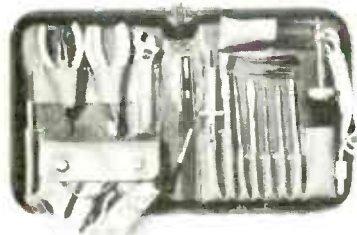
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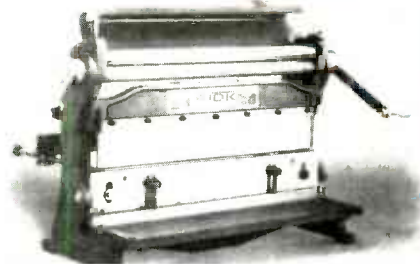
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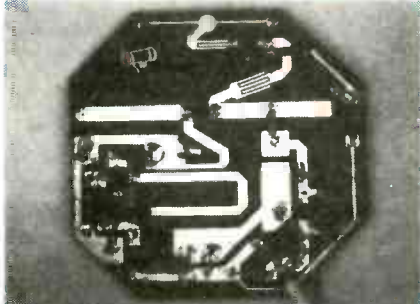
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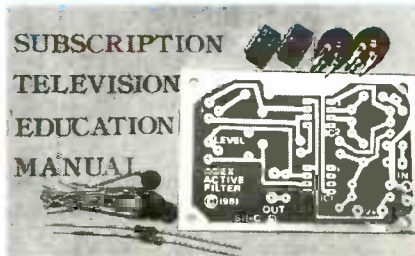
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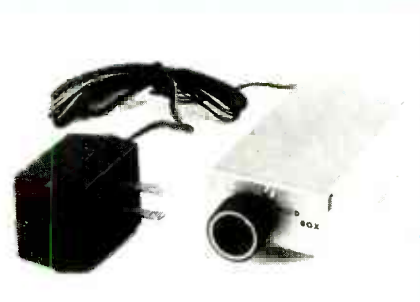
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"hold" a reading on the display by simply pressing a switch on the probe. The reading is held until the switch is released. An RF voltage probe is used to read RF voltages from 10 kHz to 50 MHz, with an accuracy of $\pm 5\%$. The VHF RF probe does the same thing for signals from 50 kHz to 520 MHz. A high-voltage probe extends the DC voltage range up to 50 kilovolts, with an accuracy of $\pm 2\%$.

The model 6500's are neat and compact bench instruments that are small enough for portable use. The test probes are sturdy, with protective collars and sharp points. The input jacks are of the type that has no exposed bare metal. The model 6502 lists for \$758.00; the model 6504 lists for 783.00. Three optional versions of each model rounds out the 6500 series. These options must be selected when you purchase the instrument; they cannot be added later. The options are: rechargeable battery-power, BCD output, and a IEEE-488 bus interface.

In summary, these are remarkable instruments—they do more things, and do them better, than anything else I own! I believe that either one would be an asset in any laboratory or electronics workshop.

In the final analysis, these instruments are anything but inexpensive. They do, however, provide features and measurements capabilities beyond other instruments in their price range. **R-E**

Radio Shack Micronta Microwave-Leakage Detector



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Radio Shack Microwave Leakage Detector										
OVERALL PRICE										
EASE OF USE										
INSTRUCTION MANUAL										
PRICE/VALUE										
	1	2	3	4	5	6	7	8	9	10
	Poor		Fair		Good					Excellent

A HANDY WARNING DEVICE FOR USE WITH microwave ovens is being marketed by Radio Shack stores and dealers through-

out the country (Radio Shack is a division of the Tandy Corp., One Tandy Center, Ft. Worth, TX 76102). The device, which incidently is **not a certification instrument**, is the *Microwave Leakage Detector* (catalog number 22-2001) and is intended for those who wish to keep a check on the door seals (and other areas) of a microwave oven.

As pointed out in the instructions supplied with the unit, new ovens will rarely allow any microwave radiation to escape. However, as ovens age and the door seals begin to wear, harmful radiation may escape without the user's knowledge. That is the value of this unit—it will detect the radiation and give a relative indication (acceptable vs. hazardous) of the level.

The detector is conveniently housed in a black plastic case that measures approximately $5 \times 2 \times 1\frac{1}{4}$ inches. The relative level of microwave radiation is indicated on an edge-reading meter located at one end of the case; that end is angled upwards for easy viewing. Acceptable radiation levels are indicated by a green region while hazardous levels are indicated by a red one. To test for microwave leakage, a gray plastic "collector" located at the other end of the case is held against the door seams of the oven being checked and then slid along the seam. Of course, the meter should be constantly watched to spot any indication of leakage.

The value of tilting the meter becomes obvious when you try the detector out. That arrangement allows you to easily see the meter without stooping as you slide the detector around the oven.

To try out the unit, we used it to check two ovens—the results were good. The newer unit was "clean" and no radiation could be found at any point tested. The second unit was considerably older. The door seals of that unit were still doing their job and no indication of radiation was observed. However, with the outer case removed from the unit, minimal radiation from the magnetron housing area of the oven was detected. It read only in the green area (about $\frac{1}{4}$ -scale) which should classify it as harmless at any reasonable distance especially since that radiation was detected only once the outer case was removed.

With the increased use of microwave ovens, a low-cost detector makes a lot of sense for the average homeowner. If that instrument were used regularly, it could protect your family from what could be a serious health hazard. Bear in mind that the leakage detector is a consumer device and is not suitable for professional or laboratory use. It is also not intended to replace the kind of thorough testing that can only be done by a professional service technician.

The Micronta *Microwave Leakage Detector* requires no batteries or other power sources and should give years of dependable service under normal care and use. It sells for \$14.95. **R-E**



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My name is Dr. George McCarty. I teach math at the University of California. I wrote this guidebook to cut through the confusion. I guide you with examples you follow step-by-step on your calculator — you do simple exercises — then you solve practical problems with real precision!

POWER METHODS. Need to evaluate functions, areas, volumes — solve equations — use curves, trig, polar coordinates — find limits for sequences and series? It's all here!

If you're in the biological, social or physical sciences, you'll be doing Bessel functions, carbon dating, Gompertz growth curves, half-life, future value, marginal costs, motion, cooling, probability, pressure — and plenty more (even differential equations).

Important numerical techniques? Those algorithms are here, too: rational and Padé approximation, bracketing, continued fractions, Euler's method, Heun's method, iteration functions, Newton's method, predictor-corrector, successive substitutions, Simpson's method and synthetic division.

LOOK AT WHAT USERS SAY: Samuel C. McCluney, Jr., of Philadelphia writes:

"CALCULATOR CALCULUS IS GREAT! For ten years I have been trying to get the theory of calculus through my head, using home-study courses. It was not until I had your book that it became clear what the calculus was all about. Now I can go through the other books and see what they are trying to do. With your book and a calculator the whole idea becomes clear in a moment, and is a MOST REFRESHING EXPERIENCE. I program some of the iterative prob-

lems you suggest and it always GIVES ME A THRILL to see it start out with a wild guess and then approach the limit and stop.

Professor John A. Ball of Harvard College (author of the book *Algorithms for RPN Calculators*) writes: "I wish I had had as good a calculus course."

Professor H. I. Freedman of the U. of Alberta, writing in *Soc. Ind. Appl. Math Review*, states:

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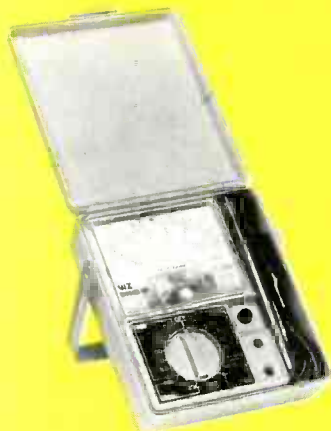
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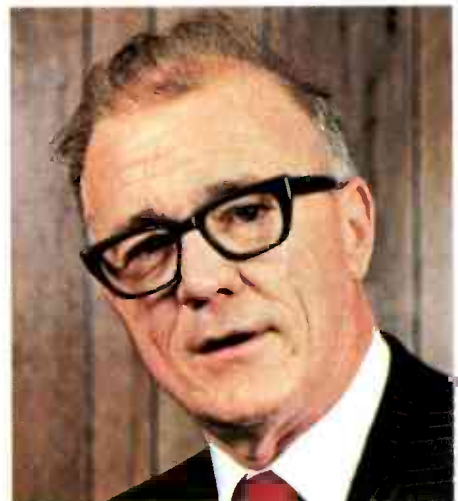
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I believe he was right. Today is the age of specialization. And I think that's a very good thing.

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I'll tell it to you straight. If you think electronics would make a nice hobby, check with other schools.

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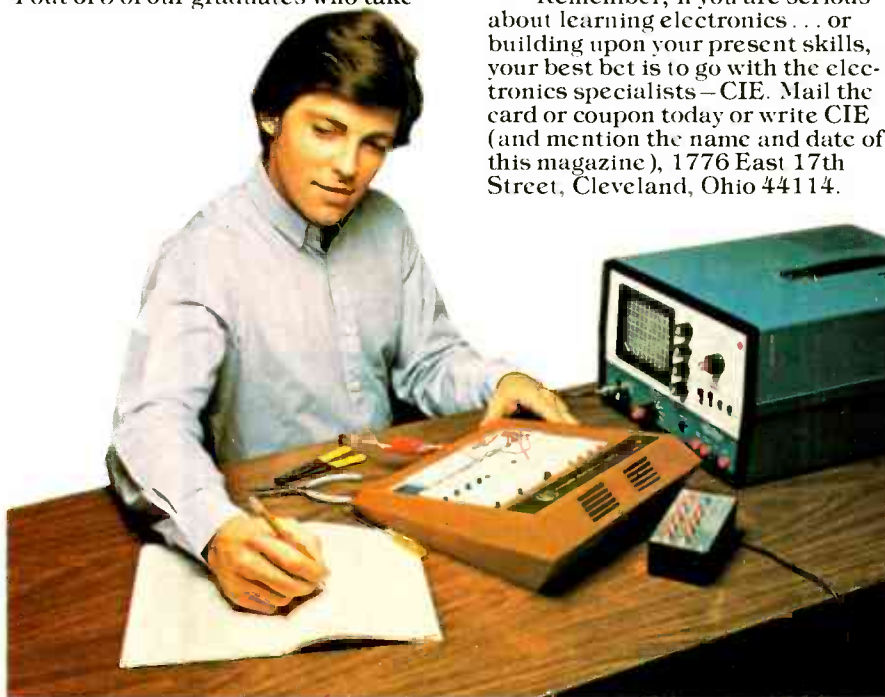
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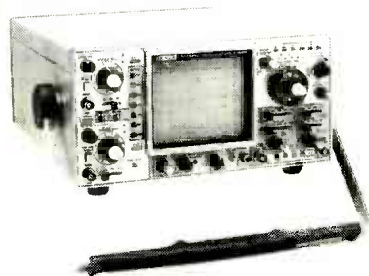
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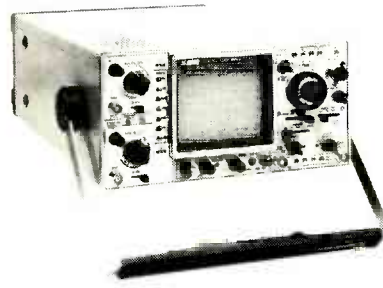
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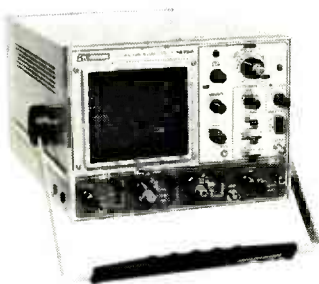
- 70MHz response
- 1 mV/division sensitivity to 70MHz
- 500 μ V/division cascade sensitivity
- Four-input operation provides trigger view on 4 separate inputs
- Alternate time base operation
- 20MHz bandwidth limiter
- Lighted function pushbuttons employing electronic switching with non-volatile RAM memory
- Switching power supply delivers best efficiency and regulation at lowest weight
- Channel 1 buffered output for simultaneous display with other instruments
- Has many of the most important features of the Model 1590
- Includes two 10x probes

The new B&K-PRECISION Model 1570 is a cost-effective full-feature portable lab scope. Having many of the important features of the 1590, the 1570 is more feature-packed and offers higher performance than most other scopes in its bandwidth class.

This 70MHz scope is useful to even higher frequencies and has a +4dB response at 80MHz. Its 1 mV/division sensitivity extends to the full 70MHz bandwidth. For applications involving low-frequency signals, a selectable 20MHz bandwidth limiter is built in.

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Dual-Trace 30MHz Triggered Scope



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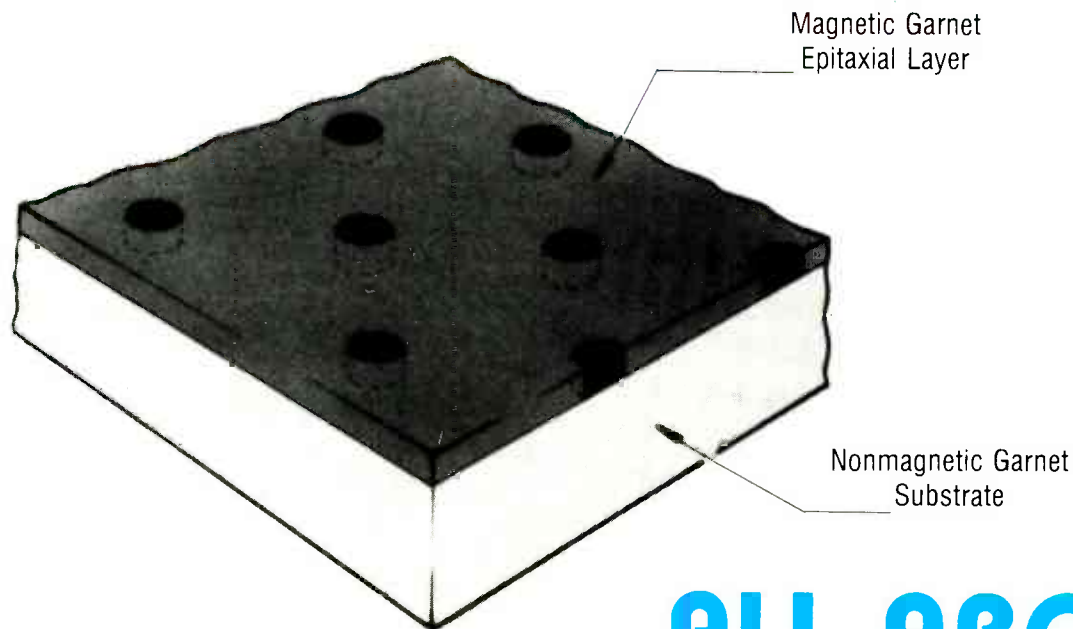


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ALL ABOUT BUBBLE MEMORY DEVICES

ROBERT F. SCOTT
SEMICONDUCTOR EDITOR

YOU'VE PROBABLY READ BRIEF ANNOUNCEMENTS OF NEW USES for "bubble memory" devices or watched as a TV science reporter demonstrated some futuristic device that would soon be made possible through the use of bubble memory. If this has given you the impression that bubble memory is a new revolutionary technology or a science-fiction-like development that will never touch your personal life, you're dead wrong! Certainly you've misdialled a telephone number and heard the following announcement: "We're sorry. Your call did not go through. Please check the number and dial again or ask your operator for assistance." This is an example of bubble memory in speech synthesis and telephone switching.

The patent covering the discovery of the magnetic bubble and the fact that bubbles can be generated, replicated and erased was granted to Bell Laboratories scientists Richard C. Sherwood, William F. Schockley, Umberto F. Gianola, and Andrew H. Bobeck way back in 1966. An article in the Bell Labs *Record*, June/July 1970 announced that magnetic bubbles can be used to record, store and read data simply by applying and manipulating external magnetic forces. The presence or absence of a bubble at a given location represents a logic "1" or "0", respectively.

In the November 1976 issue of the *Record*, Bell Laboratories announced a voice-message recorder using bubble memory technology. The analog message is encoded into a digital format and stored in the bubble memory until needed. The digitally stored data can be read out, decoded and converted back into the original voice announcement. Twelve seconds of digitized voice or twelve pages of single-space typewritten text containing 280,000 bits of data can be stored on a single 10-mm by 10-mm square chip. This puts the chip in the same class as a 250K bit memory with 64K bytes of memory storage.

The magnetic bubble memory (MBM) combines the read/write features of RAM's, the non-volatility of ROM's, and is competitive in storage capacity with tape and disk systems. Table 1 compares the performance advantages and disadvantages of bubble memories with ROM's, PROM's, RAM's, and floppies.

What is a bubble?

Essentially, magnetic bubbles are formed in a thin magnetic material that is polarized. Each magnetic bubble is a microscopic magnetic cylinder of reverse polarization to that of the thin

TABLE 1

ADVANTAGES		DISADVANTAGES
Higher reliability Non-mechanical Smaller size Faster access Simpler interface Media integrity	Bubble memory vs Floppy disk	Stored data not readily changed
Non-volatile More bits per device Reduced board space	Bubble memory vs RAM	Slower access Slower transfer rate
Programmability More bits per device Less board space	Bubble memory vs ROM or PROM	Slower access Slower transfer rate

magnetic substance that surrounds it. These bubbles are the individual memory cells in the "bubble memory" that are comparable to the individual memory cells in a conventional semiconductor memory element. The important point is that physically, they are much smaller and therefore a lot more memory capacity fits into the same amount of space. Now let's take a look at how these devices are fabricated.

The approximately 1/4-inch square bubble memory chips are fabricated onto 3-inch diameter single-crystal epitaxial garnet wafers. The wafers have two layers: a non-magnetic gadolinium gallium garnet (GGG) substrate about 0.015-inch thick supporting a grown film of magnetic garnet. (The film is 3 micrometers thick—about 120 millionths of an inch—and is composed of yttrium samarium calcium iron garnet.) Each 3-inch wafer can be sliced to yield up to 44 chips.

When the magnetic film is formed, it is magnetized at right angles to its surface so that regions of both North polarization and South polarization exist. The magnetic regions (see Fig. 1-a) are serpentine in shape and the surface areas of the North and South polarizations are equal in total size.

When an external magnetic field (bias field) is applied perpendicular to the film surface, magnetic regions having the same polarization as the bias field expand. At the same time, regions with reverse polarization shrink. As the intensity of the magnetic bias is increased, magnetic regions of the reverse polarization shrink until they become microscopic magnetic cylinders ("bubbles") as shown in Fig. 1-b.

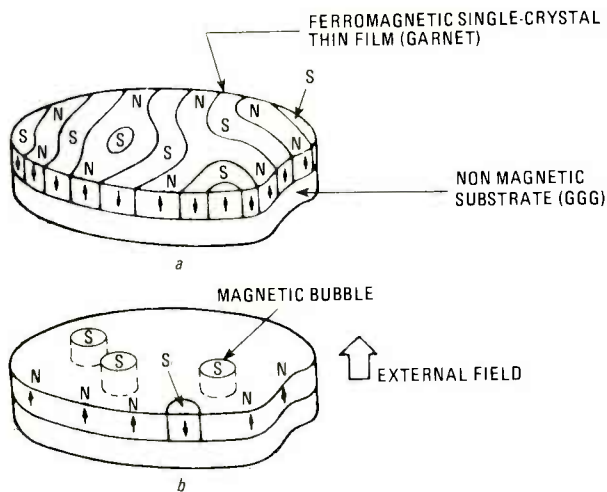


Fig. 1—WITHOUT EXTERNAL MAGNETIC FIELD the "S" and "N" magnetic domains have equal surface areas so the effective magnetic moment is zero (a). When external magnetic field (b) is applied, domains having opposite polarity shrink into microscopic magnetic cylinders called "bubbles".

The bubbles are 3 μm in diameter and are stable within a given range of bias intensity. Above this range, bubbles suddenly collapse and disappear. Below this range, they spontaneously return to the original serpentine-shaped magnetic regions.

In bubble memories, built-in permanent magnets are used to provide the correct bias intensity. Thus bubble memories are non-volatile—that is, information is not lost if electrical power is interrupted.

Variable electromagnetic fields parallel to the film's surface are used to move the bubbles laterally (like hockey pucks) around in the film. The ability to generate and manipulate magnetic bubbles is the basis for the bubble memory device. The presence of a bubble at a given location represents a logic 1; the absence of a bubble represents a logic 0.

In practice, the varying electromagnetic field is generated by a pair of electromagnetic coils wound around the chip at right angles to each other and fed triangle-waveform currents that are 90° out-of-phase. This produces a rotating electromagnetic field that propels the bubbles along a "propagation" track formed from thin-film patterns of Permalloy—a soft nickel-iron mag-

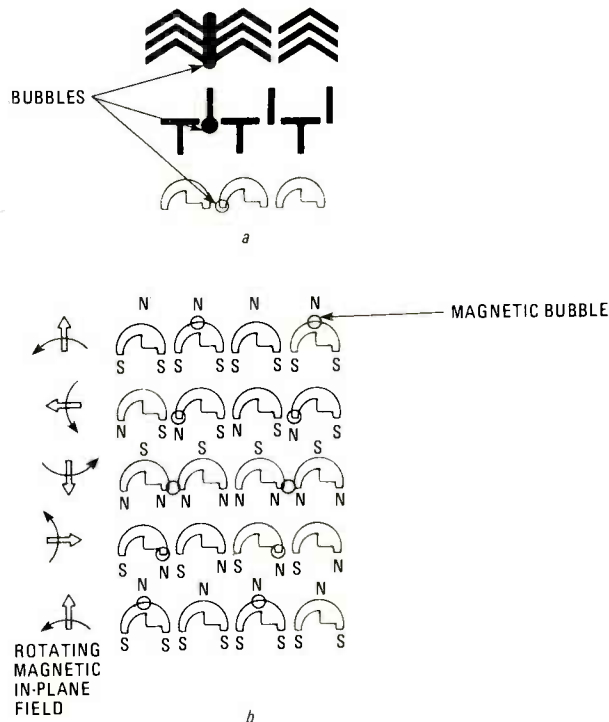


Fig. 2—PROPAGATION TRACK is made of a soft ferromagnetic material shaped as chevrons, T-bars or asymmetrical half-circles as shown in a. The rotating magnetic field changes the instantaneous magnetic polarity of the track elements; causing the bubbles to move down the track as in b. In this instance, the bubbles have "S" polarity and are attracted to "N" or North poles of the track elements.

netic material—laid down in the form of T-bars, or asymmetric "chevrons" or semicircles. See Fig. 2. The bubbles move along under the chevrons; jumping from one to the other as the polarization of the rotating bias field changes. The bubble moves one stage along the pattern for each 360° revolution of the magnetic field.

Figure 3-a shows how a simple rectangular propagation track of chevrons can be laid out on the magnetic garnet film. In practice, the track can follow various paths. One approach is a track that is compactly folded back and forth across the chip. The bubble stream is kept in continuous motion, passing a "write" head at one point and a "read" head at another point. Data is read as the bubbles make a full revolution around the track.

Figure 3-b shows the basic construction of a magnetic bubble memory device. The chip is surrounded by two right-angle coils

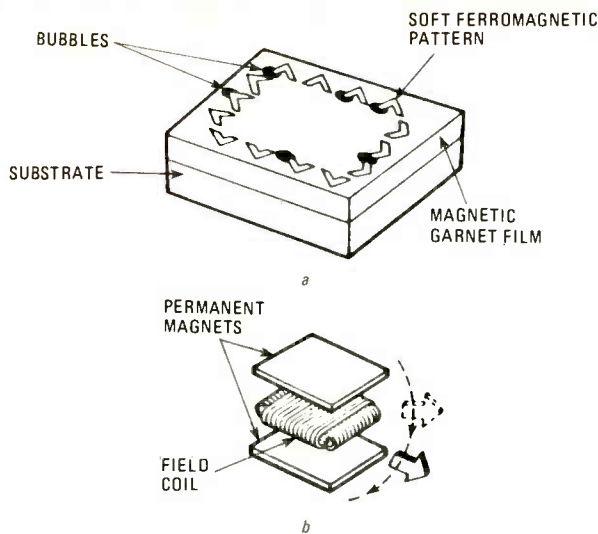


Fig. 3—PERMALLOY CHEVRONS shown in a are placed on the garnet film/by using printed-circuit techniques. They are energized by the magnetic field from a pair of crossed field coils (b) fed out-of-phase AC voltages.

to provide the rotating magnetic bias field to drive the bubbles. Thin rectangular permanent magnets are added top and bottom to develop the perpendicular bias field to generate and sustain the bubbles. These permanent magnets preserve the bubbles in the memory: even when the rotating magnetic field is removed or power sources fail. This characteristic makes the bubble memory as non-volatile as disks or tape. In addition, the permanent magnets provide a permanent magnetic field of such strength that bubbles can easily be generated, sustained, and erased.

To make full use of magnetic bubbles as a memory device, we must be able to erase or "annihilate" old bubbles, generate new ones, "replicate" existing bubbles into two new ones, transfer selected bubbles from one track or loop to another, and detect the presence or absence of a bubble at a given location and point in time.

How bubbles are generated

The bubble generator most often used is a "hairpin" conductor loop inserted between the garnet film and a special "pickax" shape Permalloy chevron on the propagation track. See Fig. 4. When a pulse of current is passed through the "hairpin" loop, it generates a magnetic field opposite to the bias field in the direction that causes a bubble to form. The bubble is

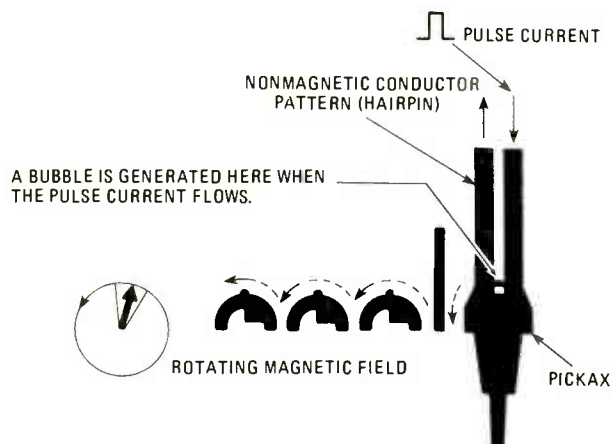


Fig. 4—A NONMAGNETIC HAIRPIN is placed between the film and a Permalloy pattern. Bubble forms if hairpin is pulsed while rotating field is oriented as shown.

then rapidly passed along the track by the rotating magnetic field. This process is repeated as data is written bit-by-bit and

stored in memory.

Switching bubble direction

Bubbles are transferred from one track to another by a Permalloy pattern (Fig. 5) similar to the bubble generator. If the "hairpin" is pulsed when the rotating magnetic field is as shown, the bubble approaching from the right is inhibited from moving leftward and is diverted upward onto the intersecting track. Here's how it works. When a bubble is located at the right "pickax" point and a pulse of current is fed through the "hairpin", field polarities momentarily block further movement to the left and the bubble is diverted into the upper path by action of the rotating magnetic field.

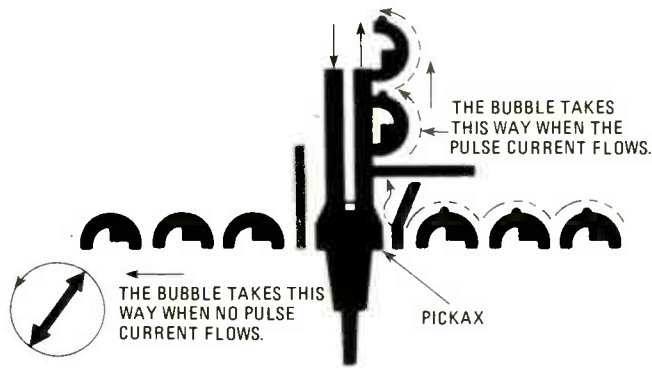


Fig. 5—PATTERN FOR CHANGING BUBBLE DIRECTION is similar to bubble generator. If current pulse is fed to hairpin when direction of rotating field is as shown, bubble is diverted upward and inhibited from leftward movement.

Bubble eraser

The method for erasing a magnetic bubble uses the same technique for switching the direction of a magnetic bubble. Instead of being shifted into or from a secondary storage loop, the bubble is removed from the storage loop and erased by an electromagnetic pulse of proper polarity.

Bubble detection

Bubble detection for data recovery can either be destructive (the bubble is destroyed and does not remain in the storage bank) or nondestructive (the bubble remains in the memory). Replication or bubble division is used in nondestructive detection. One bubble continues along the normal path and remains in storage; the other is diverted to the detector and then erased.

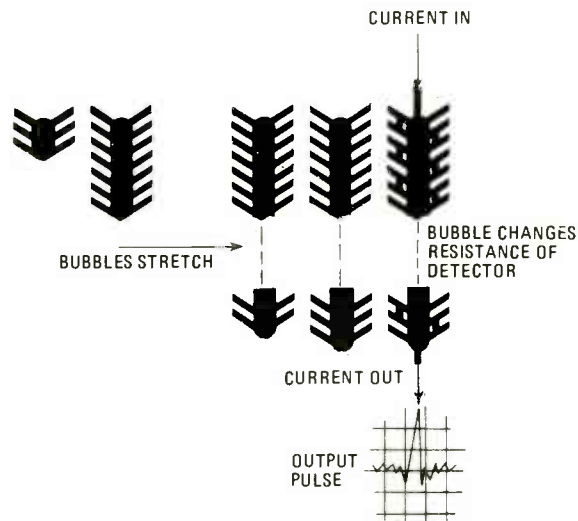


Fig. 6—BUBBLES ARE ELONGATED as they move from one "stretcher" pattern to the next. Bubbles are stretched to provide higher output from the Hall-effect detector.

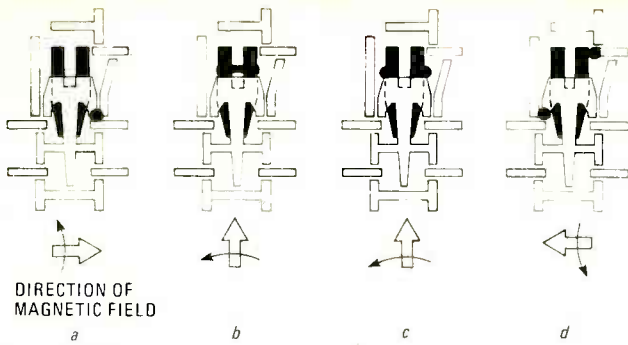


Fig. 7—BUBBLE REPLICATOR or splitter stretches bubble when rotating field angle is at (b) If hairpin is pulsed at this time, bubble splits as shown in (c). The two bubbles leave and move along different propagation tracks as field angle advances 90°.

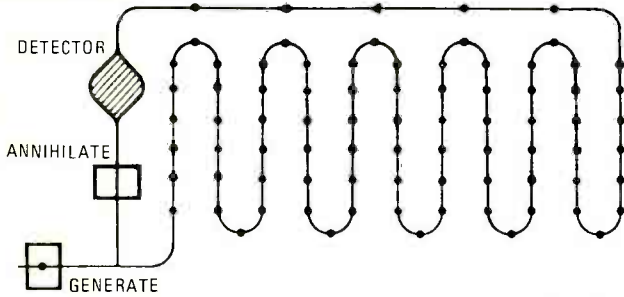


Fig. 8—THE BASIC BUBBLE MEMORY uses a serial-loop shift-register configuration. Access (or data-recovery) time is long because the data to be read must circulate through the entire loop.

The bubble to be read passes under several rows of symmetrical chevrons (Fig. 6) which causes the bubble to stretch so its length is several hundred times the normal diameter. This

much-elongated bubble is passed under a pattern of series-connected chevrons made of a special Hall-effect (magneto-resistive) material. (Hall-effect materials are those conductors whose resistance varies with the strength of a surrounding magnetic field.) A current of several milliamperes is passed through the magneto-resistive detector. As the stretched bubble passes through the detector, it causes the device resistance to drop sharply. This increases current flow sufficiently to produce an output pulse, of around 10 millivolts, that can be converted into a standard digital electronic pulse.

Bubble replicator

Figure 7 shows the replication process. It is based on the same pattern as the bubble generator and switcher. The bubble approaching from the right is elongated or stretched at the top of the pickax. It splits into halves when the hairpin is pulsed while the rotating magnetic field is in the angular area encompassed by the directional arrows. One of these bubbles is diverted upward to the bubble detector and eventual destruction while the other continues along the normal path and remains in the memory.

Bubble memory architecture

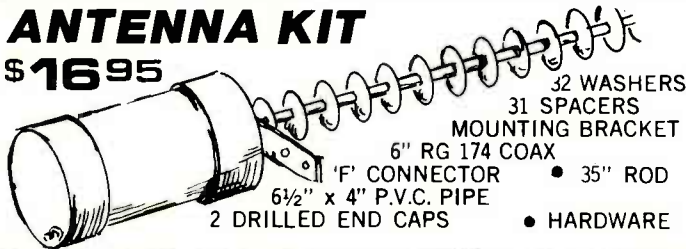
The basic bubble memory configuration is a simple serial loop shift register as illustrated in Fig. 8. This system has several disadvantages. One of the major ones is that access time is long because bubbles must circulate through the entire string of chevrons before they can be read. Access time can range from 370 to 750 ms. Another disadvantage is that perfect operation depends on a near-perfect device. Defects in substrate, garnet film, or the etched chevron pattern decrease production yield and increase cost. For these reasons most bubbles memories use architecture (system designs) that have much shorter access times and allow for many defects in chip geometry. These will be discussed in a following issue.

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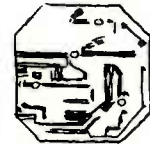
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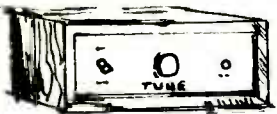
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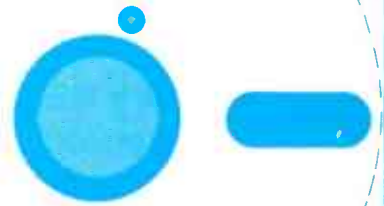
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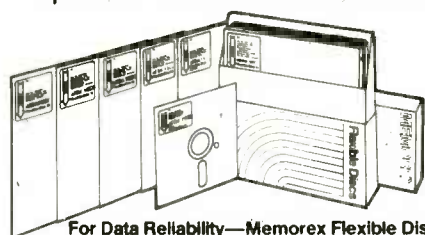
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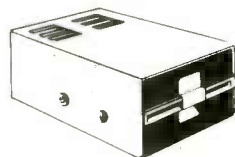
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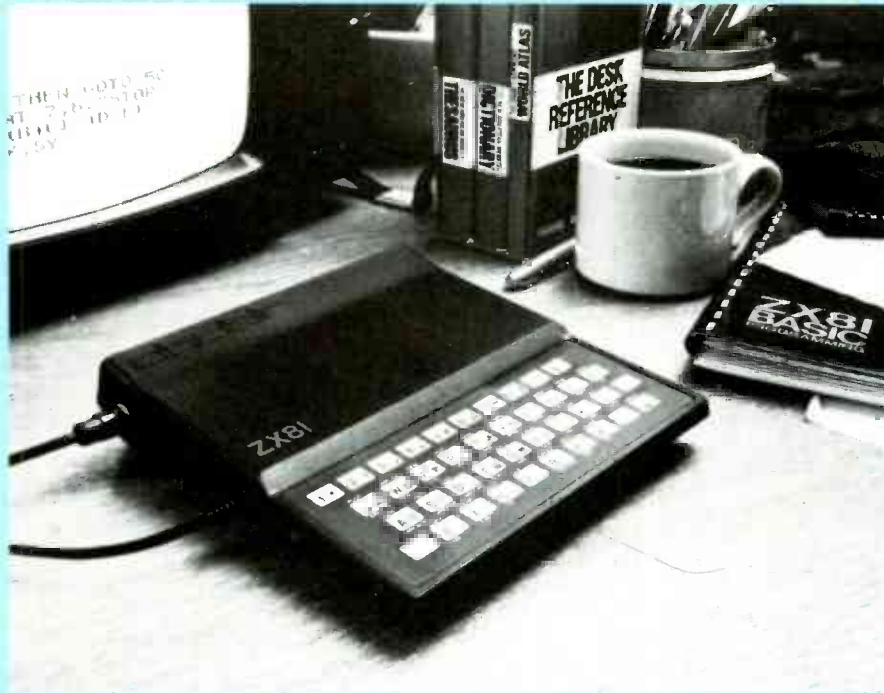
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MARC STERN

ABOUT THE LEAST EXPENSIVE COMPUTER YOU CAN FIND IS THE Sinclair ZX81, also marketed as the Timex 1000. It uses an eight-bit Z80A CPU and is available as a kit from Sinclair for under \$80, and assembled and tested from both Sinclair for Timex for less than \$100. It supports a high-level version of BASIC which is resident in the unit itself as 8K of ROM (Read-Only Memory) and which, despite its somewhat small size by today's standards, offers a number of unique and time-saving features.

The ZX81 is primarily a tool for learning how to program in BASIC and, while it is not the most sophisticated of machines on the market, it is very much so for its price class. It even becomes more sophisticated with the 16K memory-expansion module that plugs into the back of the unit.

The capabilities of the ZX81 don't end there, though. It is capable of supporting a raster-scan video display of 32 characters by 24 lines, or roughly half that of the CRT (Cathode Ray Tube) display of most other computers on the market. The tradeoff is that the display characters are double-sized.

Not only will this machine teach you a little about kit building (if you choose to take that approach), but its excellent learning guide will teach you, in clear language, how to program in BASIC. And, once you have learned to program, you can store the results of your work on tape via a built-in cassette interface.

If you are a touch typist, you probably won't like the membrane-type keyboard, even though it's laid out in standard "QWERTY" fashion. All the keys are there, but they are embossed on the flat face of the keyboard and you have to watch where you put your fingers. The keyboard appears better for the hunt-and-peck typist, rather than for the touch typist. In its favor, though, is the fact that this type of keyboard will prevent all sorts of messy accidents if there are children around the house.

A particularly interesting feature of the computer is its defined-function keys. With them, it is possible to enter an entire BASIC statement or command with just one keystroke. There is also a line editor through which you will be able to

correct mistakes when your program refuses to run.

Apparently realizing that a membrane-type of keyboard is not necessarily the best way to go, Sinclair has come out with another mini-microcomputer, the ZX Spectrum that uses a more standard one. It offers quite a bit more than the ZX81 and, while it costs more, it's scheduled to sell for less than \$350 when it arrives here late this year (it's currently available in England).

The language used is still a ROM-resident BASIC, but the Spectrum comes with 16K of RAM; thus, the user can do more with the system. And, by adding an expansion module, the Spectrum is able to address up to 48K of RAM. That is the same amount of RAM found on many more sophisticated and expensive systems and should also give this computer the ability to make use of higher-level software.

The Spectrum keyboard, too, deserves some comment. It is much like the calculator-key-type keyboard that has been offered by some other computer manufacturers. That type of keyboard has never had a great deal of success in the personal-computer marketplace and manufacturers have had to change their keyboards to more typewriter-like units. It may cause problems for Sinclair, as well. In its favor, though, the keyboard of the new Spectrum has several user-definable keys that should allow a one-stroke user call of specific functions.

The higher level of the Spectrum system is evident in its ability to address up to 100K of mass-storage space per drive on its 5½-inch floppy-disk drives.

Where the unit does fall down is in its display, which, although it offers color, is still a limited to 32 characters by 24 lines.

The ZX81 and Spectrum are only two examples of the many forms microcomputers take. They can range from a calculator-like handheld device through a larger computer-in-a-keyboard type to a full-blown, business-ready, bus-oriented machine.

Sharp/Radio Shack

Low-cost handheld microcomputers are represented by the Sharp Electronics PC-1211 and PC-1500 and the Radio Shack



THE SHARP PC-1500 uses an eight-bit CPU. It is shown here with its optional four-color printer/plotter.

TRS-80 Pocket Computer and TRS-80 Pocket Computer-2 (also known as the TRS-80 PC-2). Each computer bears two designations—Sharp's and Radio Shack's—because Sharp makes virtually identical handheld units for itself and for Radio Shack. The lower-priced PC-1211/Pocket Computer demonstrate that not all microcomputers are driven by eight-bit microprocessors. Instead, they use dual four-bit CMOS microprocessors one of which handles the arithmetic functions of the handheld, and the other of which handles the resident BASIC and input.

These handhelds are programmable in Pocket BASIC and feature a 1.9K memory that is automatically partitioned for program and data storage.

A user can load or save programs using an optional cassette interface; there is also a combination printer/cassette interface available to produce hard copy of any program.

The beauty of the handheld microcomputer is that it can be taken anywhere and be used to solve problems and perform calculations in the field. It is useful in engineering, scientific, student, and household applications, and there is software available for all those areas.

The pocket computers are advertised as having a true "QWERTY" (standard typewriter) keyboard. However, you will quickly discover from the size of the keys that if you want to enter data quickly, you had better do it one key at a time. The keys, while they have a positive feel, are a bit on the small side and don't lend themselves to touch typing. Above and to the right of the keyboard is a bank of user-definable keys by which a user can either call a predefined function or routine. Once set up they are kept in memory for the life of the computer's batteries, so you can recall them at any time at the touch of a button.

The liquid-crystal display (LCD) is limited to one line of 24 characters formed by a 5 × 7 dot matrix. When the line-limit is reached, the remaining characters are automatically dumped to the next line.

As powerful as those microcomputers are, they don't hold a candle to the much more powerful PC-1500 and TRS-80 Pocket Computer-2, both of which feature true eight-bit CPU's. But, then, the (twice) four-bit units are much lower in price, at \$160 and \$149.95, respectively.

Again, the higher-priced—\$300 for the Sharp PC-1500 and \$279.95 for the TRS-80 PC-2—pocket computers are both actually made by Sharp. As mentioned earlier, they use true CMOS eight-bit CPU's. They are fairly fast because they boast

HOW TO USE THIS SPECIAL SECTION

FIFTEEN YEARS AGO YOU NEVER WOULD HAVE BELIEVED IT! WHO would have thought there would be a day when a sophisticated computer would be available for less than a mega-dollar figure? After all, didn't computers require racks upon racks of components, displays, tape drives, card readers, and so on?

But, look at what's happened. Computers are everywhere! Computers have shrunk several orders of magnitude in size and price, and the computing power of a machine that used to occupy an entire room is now available in a device that you can slip into your pocket. Prices have fallen correspondingly, and that handheld computer may cost less than the suit whose pocket it's being carried in.

Responsible for the revolution is the integrated circuit, or IC. Just as transistors replaced vacuum tubes in early mainframe (big) computers, IC's—containing thousands upon thousands of transistors—have replaced those discrete semiconductors. Circuits that used to occupy an entire equipment rack now fit on a "chip" of silicon smaller than your fingernail—and that piece of silicon into a "package" smaller in volume than your thumb.

A whole CPU (Central Processing Unit—the heart of a computer) like the Z80, 6502, or 6800 can be had for under \$7.00; just look at the ads at the back of this magazine! Similarly, computer-memory IC's have dropped tremendously in price, while their capacity has increased dramatically. Just a few years ago, 16K (about 16,000 characters' worth) of memory for Radio Shack's original TRS-80 computer was a *bargain* at \$120.00. Today, the same memory IC's are available for about 1/6 that price. Along the same lines: Not too long ago, the most common memory IC had a capacity of just 1K (1024 bits); eight of them would give your computer 1K of memory. Today, a single IC can provide sixteen times the capacity of the older ones, at less than half the price—and the trend continues.

Price decreases brought about by advances in technology, together with the fact that computers are now *mass-produced* rather than built individually, have made small computers for

the home and business an affordable reality.

In this, the hardware portion of the "Your Own Computer" supplement to **Radio-Electronics**, we'll look at small-computer systems in order of increasing price—from \$100 (or less) to over \$4500. Within each price category we'll describe the equipment available, based on information supplied by manufacturers. You should bear in mind that options other than those shown exist for almost all systems, and that the prices shown in the tables apply specifically to the items described there. If a printer is mentioned, its price is included in the total shown. If a printer is *not* mentioned, that does not mean it is unavailable: such devices as printers and disk drives, known as *peripherals*, are generally available from a number of sources other than the computer manufacturer. Before we plunge into descriptions of the computer systems themselves, let's consider how a system can be configured—either by a manufacturer or by you.

Peripherals in general

Many—but not all—computers can be purchased ready to plug in and run. They will usually come with a certain (minimal) amount of memory, and have provisions for a video display and for storing programs and data on audio cassettes or floppy disks. The display and storage devices may or may not be included in the purchase price (check the tables carefully when you're making price comparisons). While printers may be offered by a manufacturer, they generally are not included in the price of the computer system.

Regardless of whether or not a particular device is included in the entire system package, the computer can usually be purchased without it and, in many cases, you will want to do that and then add the peripherals that will best meet your needs.

Computers and memory

Without memory, a computer is useless—it has no place to store a program or to manipulate data. Most computers come

1.3-MHz clock speeds; in fact, their speeds are comparable to those of some full-featured personal computers. These second-generation devices recognize 42 statements, 34 functions and 6 commands, which are accessible from the 65-key keyboard.

They are able to handle complex programs thanks to an Extended Pocket BASIC language that is resident in ROM. In fact, the user has direct memory access and these machines can easily handle maskable and timer interrupts. Just those functions, alone, give you an idea of the power of the computers. More is added by their string-handling capabilities. They are able to handle 80-character, two-dimensional arrays and will recognize such commands as LEFT\$, MID\$, RIGHT\$, LEN, VAL, CHR\$, and STR\$ (refer to a good text on BASIC to see how valuable those can be).

The keyboard, also set up along "QWERTY" lines, but which really isn't suitable for fast data entry due to its small keys, features 18 programmable keys, 18 "softkeys" and 10



THE RADIO SHACK TRS-80 Pocket Computer uses two, four-bit, micro-processors.

with a minimal amount of memory, usually ranging from 4K to 16K. While that is adequate for game-playing and simple home applications, a computer used for more serious purposes will generally require at least 48K of memory. Most of the computers mentioned here can be expanded to that point, or beyond.

A few computers—the "micro-mainframes," which are used in high-end microcomputer systems—are available with no memory or CPU at all. Some of them are shown in the low-end tables, but you should bear in mind that the price shown is for just the skeleton of the system—a chassis, power supply, and motherboard (the board that carries the bus signals); everything else is extra. The same, or a similar, mainframe will normally be found with add-ons in a higher-level table.

External data-storage

Every computer comes with either a cassette interface or a disk drive (or drives) to allow programs and data to be stored for future use. The tables shown a typical configuration for the price range in question. In almost every case there are options available to the user—either from the computer manufacturer or from outside suppliers—to permit the addition or expansion of disk facilities. Those, of course, will increase the price of the overall system. Add-on floppy-disk drives start at about \$500.00 and can cost several thousand dollars for a dual, double-sided, double-density eight-inch system capable of storing about two megabytes (two million bytes = 16 million bits).

Winchester disk systems, capable of storing five megabytes and more, start between \$2000 and \$3000 but—at least these days—are used mostly for "serious" applications.

If you can afford it, you should have a two-drive system. Not only will you enjoy a greater storage capacity, but you will also find it much easier and faster to copy files from one disk to another. Perhaps more important is the fact that, if the capacity of a single disk is rather small (100K or less), it may not be possible for it to hold the DOS (Disk Operating System), program(s), and the data you will require. It's better to use the first drive of a dual-drive system for the DOS and program, and the second for data.



preprogrammed command keys.

These computers are easily able to handle such tasks as process control, data logging, and instant monitoring via an add-on RS-232C serial port. A communications package that will allow a person to use the computers as intelligent terminals for phone line access (electronic mail is also a possibility) is scheduled soon.

Through the 60-pin connector on the side, these units can be connected to either a cassette interface or a combination color printer-plotter cassette interface. That gives the user access to already existing cassette-based software and allows him to create and save his own programs and data files. The mass storage is only limited by the length of the cassette tape, and a short tape will hold plenty!

Printers

When a printer is shown as part of a system in one of the tables, it is usually a medium-priced model, and is included to give you an idea of what the entire system-price would be.

Printers are available starting from about \$300 and going up to more than \$3000. Generally the print quality improves as the price increases; sometimes speed is also a factor tied into price. The recent introduction of several letter-quality daisy-wheel printers for under \$1000 is something that has long been waited for, and should make putting together a system able to provide typewriter-quality output a much less expensive proposition than it has been until now. The quality is achieved at the expense of speed, but the sacrifice should be worth it to many.

Input/output devices

Most computers require a keyboard for input and some kind of video display for output. Inexpensive computers usually have a built-in keyboard or keypad and provisions for connection to a video monitor or TV receiver. In the case of the latter, an RF modulator will be required if it is not built into the computer. Some computers, like Commodore's *CBM* line, and the *Osborne I* have everything built in. Others, primarily the "micro-mainframes," supply nothing; a terminal—a combination keyboard and display unit—must be added. Terminal prices start at around \$600.

We've tried to indicate what the situation is with regard to each computer, but bear in mind that some, like the *Apple II*, may offer you several options for a display device.

How to read the tables

The tables included with each price-category section show which computers, features, and accessories you can expect to find in a typical system within that price range. If a system has been upgraded from a previous table, the new information appears in color. The tables will give you an idea of what you can get for a given price; a local computer store will be able to answer your questions and tailor a system to your specific requirements.

R-E



A COMBINATION computer, video game, and music synthesizer, the *MAX Machine* is Commodore's least expensive model.

Furthermore, the printer/cassette interface, allows two cassette recorders to be connected to make file handling simpler and to provide greater storage capacity.

Admittedly, the 4K of RAM that comes with these computers isn't very much, but it can be expanded to 16K through a plug-in module.

Again, the displays are LCD's with 7-by-156-dot resolution. Special alphanumeric or graphics characters can be user-

defined—a further indication of the power of these units. That isn't all that is user-definable, though. The size of the printer characters, as well as their color (there are four to choose from), can also be defined. The printer can be used for plotting as well as for hard-copy backup of any programs you may have written.

Commodore

Leaving the handheld microcomputers and returning to the computer-in-a-keyboard types, we find they are offered by some famous names in the computer and home-entertainment fields. One such company is Commodore Business Machines—originators of the *PET* computer.

Commodore manufactures several keyboard-only (the entire computer is housed inside the keyboard enclosure) machines. Perhaps you have heard of the *VIC 20*. It is one of theirs, as well as is another under-\$500 unit known as the *MAX Machine*.

At one time, the *VIC 20* was the low end of the CBM lineup; at \$295, it certainly is inexpensive. However, it has been replaced as Commodore's least expensive model by the *MAX Machine*, which has a price tag of \$179.95. What is common to both units, and the rest of the Commodore lineup (except for the very-top-of-the-line model), is an eight-bit microprocessor. All CBM machines are driven by one form or another of the 65xx (6502, 6509, 6510, etc.) family of CPU's.

TABLE 1—\$100-\$500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Atari Home Computers 1192 Borregas Sunnyvale, CA 94086	Atari 400	\$299	6502B	8 bits	N/A	BASIC assembly, Pilot
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	VIC 20	\$295	6502	8 bits	N/A	BASIC
Commodore Business Machines	CBM MAX	\$179	6510	8 bits	N/A	BASIC
Heath Co. Benton Harbor, MI 49022	H-8	\$350 (kit)	8080	8 bits	N/A	BASIC
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI Superboard	\$350	6502	8 bits	N/A	BASIC
Netronics Research 333 Litchfield Rd. New Milford, CT 06776	Explorer 35	\$129.95	8085	8 bits	N/A	machine
Netronics Research	ELF II	\$99.95	1802	8 bits	N/A	machine
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Pocket Computer (PC-1)	\$149.95	2 custom CMOS	4 bits	N/A	BASIC
Radio Shack	TRS-80 Pocket Computer 2 (PC-2)	\$279.95	CMOS		N/A	BASIC
Radio Shack	TRS-80 Color Computer	\$399.00	6809	8 bits	N/A	BASIC
Sharp Electronics 10 Keystone Pl. Paramus, NJ 07652	PC-1211	\$160	custom CMOS	2 x 4 bits	N/A	BASIC
Sharp Electronics	PC-1500	\$300	custom CMOS	8 bits	N/A	BASIC
Sinclair Research Ltd. 50 Staniford St. Boston, MA 02114	ZX Spectrum	under \$300	Z80A	8 bits	N/A	BASIC
Sinclair Research	ZX81	\$99.95 (\$79.95 kit)	Z80A	8 bits	N/A	BASIC
Timex 1579 Straits Tpke. Middlebury, CT 06762	Timex 1000	\$99.95	Z80A	8 bits	N/A	BASIC

The *MAX Machine* is a three-in-one computer. It is a computer, a game machine, and a music synthesizer, all in one package. It has a membrane keyboard but, rather than being completely smooth, the keyboard has indentations where the keys are. That should make it much more convenient to use. It's a compromise between a full-keyboard, such as the one found on the *VIC 20* and the flat membrane-type keyboard used by the *ZX81*.

The CPU in the *MAX Machine* is a 6510. It differs from other 65xx-series CPU's in that it has more input and output lines. It can "play" not only arcade-type games, but also educational and musical ones. The firmware—program-containing IC's within the machine—is capable of generating 16 colors and 3 independent, 9-octave voices for 3-part musical harmony.

You don't have to rely on pre-programmed game cartridges for this computer. Instead, you can write your own programs, creating your own characters and games, and then save them on cassette tape for future use.

But, the *MAX* isn't just a game machine. It is also a home computer, capable of being programmed in BASIC (or as CBM calls it, "MAX Machine BASIC"). The *MAX Machine* is capable of nine-digit numeric accuracy and features a range of built-in math functions. It can handle both words and math strings, and its BASIC can be translated for use with other CBM



computers.

There are several peripheral devices available, not the least of which is the sophisticated Sound Interface Device. With that unit, the *MAX Machine* can produce music and sound effects which may rival those of other music synthesizers now on the

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/cassette interface		57 keys, membrane	4 serial,		
5K/cassette interface		66 keys, 4 user-programmable	serial, parallel		
N/A/cassette interface		64 keys, 4 user-programmable	N/A		
		16-key keypad	N/A	N/A	micro-mainframe
4K/cassette interface		standard	serial		
256 bytes/cassette interface			serial		
256 bytes/cassette interface		hex keypad	N/A		
1424-step/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
4K/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
4K/cassette interface		53 button-type keys	serial	8 colors, 192 x 256	
1424-step/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
3.5K/N/A		65 keys, 6 user-programmable, 3 levels	N/A	24-character LCD	
16K/cassette interface		standard	serial	32 x 24 text	
1K/cassette interface		membrane	N/A	32 x 24 text	
1K/cassette interface		membrane	N/A	32 x 24 text	



ANOTHER INEXPENSIVE MACHINE from Commodore, the VIC 20's memory can be expanded to 32K.

market. You can create not only three-part harmony over nine octaves, but can also program the attack, decay, sustain and release times through an ADSR (Attack, Decay, Sustain, Release) generator. The sound section also has a programmable filter and offers variable resonance.

The computer has a built-in RF modulator so it can be used with an ordinary color (or black-and-white) TV receiver. Mass storage is via a cassette recorder.

The other under-\$500 CBM unit is the VIC 20 mentioned previously. Driven by an 8-bit 6502, the VIC 20 is a powerful home/game computer. It comes with 5K of RAM, but that is probably insufficient for most operating tasks so it is advisable to obtain one of the plug-in memory expansion modules, available in 3K, 8K, and 16K sizes; thus, it is possible to increase the amount of RAM to 32K. The system language is ROM-resident Pet BASIC.

This is a good system on which to learn programming—CBM supplies a very good BASIC primer that leads you step-by-step through the language.

Although the system is aimed at the low-end market, it is capable of being expanded into quite a powerful one. The 66-key keyboard has a number of dual function keys (the alternate functions are indicated on the fronts of the keys).

While the keyboard is more-or-less standard, some of the keys seem out of place when compared to other layouts. For example, the colon/semi-colon functions are on two separate



THE MEMORY CAPACITY, and the sophistication, of the Sinclair ZX81 can be increased by adding a 16K memory-expansion module.

AS WE GO TO PRESS

M/A-COM-OSI has announced that it is discontinuing many of its personal computer lines. The only systems that will remain in production are the C4P-MF-48K, which has been renamed the C100; the C2-OEM, now the 220C; the C2D, now the 220E; the C3-OEM, now the 240C; the C3D, now the 230E; the C3C, now 250I, and the C3B, now the 250J. Be aware that while the other OSI systems mentioned in this section may remain available for some time, the availability of future support for those systems is highly questionable.

keys, and they are not located—as is usually the case—under the right hand. That may prove awkward for someone used to programming on a typewriter-style keyboard, as may "out of place" quotation marks.

This computer, too, has a built-in RF modulator for use with a TV set. The display is a double-sized 22 characters by 23 lines, which is about one-quarter that of other, more expensive personal computers. Graphics resolution is a respectable 176 by 184 pixels (Picture Elements) and the user has 16 colors from which to choose.



A WIDE VARIETY of peripherals are available for upgrading the Radio Shack TRS-80 Color Computer.

The expansion capabilities of the VIC 20, though, compensate greatly for the shortcomings of the keyboard and display. After more memory is added, system expansion can continue with the addition of a single, double-density 5¼-inch floppy-disk drive. That adds 170K of mass storage to the system. As with most Commodore equipment, an IEEE-488 interface is provided; an RS-232C serial port can be added.

For hard-copy backup, an 80-column dot-matrix printer is available, which does make this system a complete home-computing system. For telecommunication applications, it is capable of interfacing with other computers via the phone lines through the use of the VICMODEM.

Not only is the VIC 20 a learning tool, but it is also capable of doing word processing with the additional of the VICWriter cassette. And, if that's not enough, it can also generate music through four tone-generators and games can be played using joystick controllers.

Radio Shack

Another of the keyboard-type computers on the market is the TRS-80 Color Computer, manufactured by Radio Shack. At \$299 for a 4K unit, it is not expensive, but it does pack quite a lot of potential.

In its most basic version, this 6809E-driven computer has 4K

of RAM, which, admittedly, is a bit limited for serious computer work. However, the situation can be corrected with the addition of plug-in RAM. The *Color Computer* can have its RAM expanded to 32K this way. In fact, to advance from the more limited Color BASIC programming language to the more-powerful Extended Color BASIC, you need a minimum of 16K of RAM. Both BASIC's are ROM-resident.

The number-crunching (calculating) capabilities of this system are slowed by its low clock-speed of .894 MHz, although it should be perfectly adequate for the many videogames available for this unit.

The *Color Computer* features a respectable resolution of 192 × 256 pixels and it is capable of generating up to 8 colors. With the extra RAM and the Extended Color BASIC installed, it is also capable of handling some fairly sophisticated tasks. For instance, not only is it capable of data and string handling, but it can also handle dimensional arrays and has nine-place accuracy in its math functions. The Extended Color BASIC also provides for sophisticated graphics, allowing such character generation as creating circles, drawing figures, or screen painting.

String arrays of as much as 255 characters in length are also allowable, as is user-definition of memory content through the use of PEEK and POKE commands. Machine-language routines can be called from BASIC for use in programs that are written in that language.

Although the system is capable of expansion into a fairly powerful home computer due to the large number of peripherals available, the display-limit of 32 characters by 16 lines, which seems adequate for game playing and some programming, would seem to be restrictive for word processing.

A wide variety of peripherals is available, including a color receiver, cassette recorder, joystick controllers, 16K RAM upgrade, 32K RAM upgrade, Extended Color BASIC, modem, Editor/Assembler module, printer, mini-floppy disk drives and plug-in controller pack.

The 53-key keyboard is another of the button-types and it seems to have found a comfortable niche in this computer. As you can see, this unit can be made into quite a powerful system, and we'll look at it more fully further on.

Atari

The last of the computers-in-a-keyboard is the Atari 400. Perhaps Atari is best known to you as an electronics game specialist, but it's a short step from providing high-level-graphics video games to providing home computing power, and Atari has now made it with its \$299 Atari 400.

This computer is another one using a membrane keyboard, which is a plus where children or coffee spills abound, but which can slow down a touch typist.

Unlike other keyboard-computers on the market, the 400 seems to lack a one-key function option. Where other computers, like the Sinclair, allow a user to have single-stroke access to a programming function and the keyboard is labeled as such, the keyboard of the Atari 400 has no such provision.

Its primary strength seems to lie in its educational value. There is a large amount of cassette-based educational software available for this unit, as well as games and communications software. Additionally, there is a BASIC-programming course available.

Peripherals available include a cassette recorder and a communications interface, which allows you to connect to various databases, such as The Source and the Dow Jones Information Services. The "Communicator" package includes the phone-interface module, acoustic modem, and the Atari Telelink firmware that makes it all work.

M/A COM OSI

The M/A COM-OSI *Superboard* is a building-block type of personal computer that starts out as a complete computer on a board. What that means is that the board contains the CPU, memory, and all the I/O lines needed to make it a working unit. All that has to be added is a 5-volt DC power supply and a video



display. Included in this \$350 unit are 4K of RAM, expandable to 8K, along with 8K of ROM-resident BASIC. The unit also contains video-output circuitry, a cassette interface, and an integral keyboard.

Netronics

Continuing in this vein, we come to the venerable epitome of the "roll your own" computers, the \$99.95 *Elf II* from Netronics. It is one of the oldest single-board computer kits on the market and is based on the RCA 1802-series CPU. For the record, it is one of the last computers on the market to make use of Tiny BASIC.

The *Elf II* is constructed on a small PC board, and uses a hex (hexadecimal) keypad for programming in machine language. A composite-video signal is also generated for display on a monitor or on a TV receiver equipped with an RF modulator. RAM is a rather limited 256 bytes, but that is expandable to 64K. (The *Elf II* is very expandable for a single-board machine—about half the board area is reserved for that purpose.) A full keyboard is available as an option. Another peripheral is a A/D-D/A converter board.

A far more complete "roll your own" personal computer is Netronics' *Explorer 85*. It can be built into a rather powerful system. A two- or six-slot S-100-bus (more about the S-100 bus later) can be added, and from there, expansion is virtually unlimited. There are many expansion peripherals available, including RAM boards, of course, which can turn this system into a powerful eight-bit machine. They include keyboards, CRT, eight-inch disk drive, floppy-disk controller, audio board, light pen, hex keypad, cabinetry and the CP/M disk-operating system.

Micro-mainframes

The final under-\$500 category consists of the micro-mainframes—bare-bones computers (sometimes without even a CPU)—that can be expanded into extremely complex and capable systems. They usually use the S-100 bus, an arrangement that uses 100 lines to carry address, data, and control information to and from the various boards that are plugged into it. The S-100 bus was the first microprocessor bus, and is still going strong, especially in high-end computers.

Among computers that can be considered micro-mainframes, are the Heath *H8*, and the IMSAI *8080* and *8015*.

The *H8*, in its basic form for \$350 (kit), provides you with a power supply, motherboard, CPU and monitor ROM, an octal keypad, and a 7-segment LED display.

The IMSAI's, and others like them, in their least-expensive kit version, give you an enclosure, motherboard (usually S-100), and power supply. Everything else is optional, but because there are several hundred boards available for the S-100 bus, the sky's the limit when it comes to putting together a complete system.

R-E

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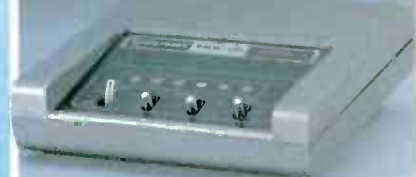
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MARC STERN

You might be surprised at how much computing power you can get at a modest cost. Here's a look at what's available in this price range.

IF YOU THINK THE LEVEL OF SOPHISTICATION AMONG THE \$100 TO \$500 microcomputers is high, then that of those in the \$500 to \$1000 range is truly amazing.

One thing that becomes apparent looking at the variety of microcomputers in this category is that the dominant CPU choice of the computer industry is the eight-bit microprocessor. In fact, it is still the king of the home computer realm, although the 16-bit micro is beginning to make its presence felt.

In this price category, we find both handheld and desktop computers. For instance, both the Radio Shack and Sharp handhelds have peripheral equipment that can put them into this segment. The printer/cassette interface available for both costs nearly \$250 and pushes both Radio Shack's *PC-2* and the Sharp's *PC-1500* over \$500. Opting for the cassette interface only will keep the price below \$500, though.

Panasonic

And, speaking of handheld computers, we now come to the Panasonic *RL-H1000* and *RL-H1400*. Though their CPU's are not specifically identified, it looks as if they are eight-bit devices. These two computers are building blocks for a true briefcase-portable microcomputer system. Though the \$500 *RL-H1000* comes with only 2K of RAM, and the *RL-H1400* only 4K, these are amazing units.

Both use the SNAP operating system, which is derived from the FORTH language. Among the programming languages the



ONCE A DREAM, hand-held computers, such as this one from Panasonic, are readily available at a relatively low cost.

computers recognize is BASIC, and you can work in BASIC using the 65-key keyboard, which is laid out in typewriter fashion. (Although it is arranged in the "QWERTY" pattern, like the other handhelds, the small size of the keys seems to preclude touch typing.)

As with other handheld computers in this price range, you can both perform immediate arithmetic calculations and run programs on these units because a calculator function is built in.

It is in the system's expansion capabilities that their real power can be seen. Not only are they interfaceable with a video display via a video/RF adaptor (RF modulator), but they also have an RS-232C interface, along with a programmable modem, plus an I/O adaptor for those and other peripherals. There are also, of course, RAM expansion modules.

You can take the systems into the field and use them as remote terminals to communicate with a computer at another location or you can use them as full stand-alone systems to solve problems on the spot.

Although both basic units fit into the under-\$1000 price category, a little memory expansion is enough to push them into the next higher one.

Other systems

Carryover exists not only among the handheld computers, but also among the home/game computers, too. For instance, even though the Atari 400 has a base price of \$299, it isn't inconceivable that by adding the telephone interface and modem, plus a couple of program cartridges and the game controllers, that the price of the unit could rise well above \$500. The same is true of the Commodore *MAX Machine* and *VIC 20*, which have a broad range of peripherals available.

Look at the Radio Shack *Color Computer*. A 16K cassette-based system (as opposed to the now-discontinued 4K system) with Extended Color BASIC costs \$499.95; increase the RAM to 32K and the price rises to \$649.95. A cassette recorder, needed for program and data storage (unless you have a more expensive disk-based system) costs an additional \$60.

But, the added capabilities you gain from any of the expanded systems more than outweigh the extra expense.

Radio Shack

The \$500-\$1000 price category is not only the home of the expanded handheld and home/game computers, but is also the starting point for other, more powerful systems. For instance, a

4K. cassette-based *TRS-80 Model III*, an important personal and small-business computer (particularly when expanded) is priced at \$699.

Yet, look at what you get for the money. You get a self-contained 12-inch black-and-white CRT with a 65-key keyboard. There's also a 12-key keypad for rapid numerical entry. The display is memory-mapped, which means that you can define various graphic elements and also instruct the computer to arrange its display exactly to your liking. The display size is

slightly smaller than usual, at 64 characters by 16 lines but allows the use of a double-sized display (32 by 16), which can be useful in some cases.

From this modest starting point a very powerful system can grow. The *TRS-80 Model III* can easily be fitted with an RS-232C serial board, so communications potential, important for many applications, is already there.

The Level I machine is no slouch when it comes to work. Its BASIC is capable of supporting a 48 by 128 graphics display,

TABLE 2—\$500-\$1000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Atari Home Computers 1192 Borregas Sunnyvale, CA 94086	Atari 800	\$899	6502B	8 bits	N/A	BASIC
Commdore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	Commdore	\$595	6510	8 bits	N/A	BASIC
Commdore Business Machines	Commdore P128	\$995	6509	8 bits	N/A	BASIC
Commdore Business Machines	VIC 20	\$769	6502	8 bits	N/A	BASIC
Cromemco, Inc. 280 Bernardo Ave. Mtn. View, CA 94043	System Zero	\$995	Z80A	8 bits	N/A	BASIC
Formula Int'l. 12603 Crenshaw Hawthorne, CA 90250	Pineapple	\$645	6502	8 bits	N/A	BASIC
Imsai Comp. Div., Fischer-Freitas Corp. 910 81st Ave., Oakland, CA 94621	I-8080	\$799	8080	8 bits	N/A	
Imsai Comp. Div., Fischer-Freitas Corp.	I-8080K	\$599	8080	8 bits	N/A	
Imsai Comp. Div., Fischer-Freitas Corp.	I-8085	\$950	8085	8 bits	N/A	
Imsai Comp. Div., Fischer-Freitas Corp.	PCS-8015	\$750	8080	8 bits	N/A	
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI C1P	\$565		8 bits	N/A	BASIC
NEC Home Elec. 1401 Estes Ave. Elk Grove, IL 60007	NEC PC-8001	\$995	uPD 780 c-1 (Z80-like)	8 bits	N/A	NBASIC
Newtronics Research 333 Litchfield Rd. New Milford, CT 06776	Explorer 85	\$886	8085	8 bits		BASIC
Panasonic 1 Panasonic Way Secaucus, NJ 07094	RL-H1000	\$500		8 bits	N/A	BASIC
Panasonic	RL-H1400	\$600		8 bits	N/A	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Color Computer	\$700	6809	8 bits	N/A	BASIC
Radio Shack	TRS-80 Model III	\$699	Z80	8 bits	N/A	BASIC
Radio Shack	TRS-80 Model III	\$999	Z80	8 bits	N/A	BASIC
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$525	TMS9900	16 bits	N/A	BASIC
Texas Instruments	TI-99/4	\$450	TMS9900	16 bits	N/A	BASIC

single dimension arrays and limited string variables. All that isn't bad in a machine which has only 4K of RAM, but it also points out the need for the next step up in the Radio Shack line, the \$999 TRS-80 Model III, Model III BASIC, 16K machine, which has much greater capabilities.

For instance, the Model III BASIC that works with this system is far more extensive in scope than the Level I BASIC. It has an extensive command set, and permits multidimensional arrays and comprehensive string variables. It also allows auto-

matic line numbering when writing programs. The Model III BASIC also supports a TRACE mode of program debugging and also allows the use of the PEEK and POKE commands so you can not only have direct access to specific memory locations, but can also look at the contents of a given memory location. This greatly enhanced version of BASIC will also support machine-language subroutine calls, and provides 16-digit accuracy—that high degree of accuracy can prove to be particularly valuable in accounting applications.

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K RAM/cassette		61 keys, 4 special function	serial, parallel	320 × 192, 16 colors, 40 × 25 text	
64K/cassette		65 keys, some user definable	serial, parallel		
128K/cassette		94 keys, some user-definable	serial	320 × 280, 40 × 25 text, 16 colors	
5K/cassette	printer/cassette	66 keys, 4 user-programmable	serial, parallel		
1K		N/A	N/A	N/A	micro-mainframe, 3 slots
64K		N/A	N/A	N/A	kit
		front panel	N/A	N/A	micro-mainframe, 20 slots
		front panel	N/A	N/A	micro-mainframe, 20 slots, kit
		front panel	N/A	N/A	micro-mainframe, 20 slots
			N/A	N/A	micro-mainframe, 20 slots
8K/cassette		full keyboard	serial	24 × 24 or 48 × 12 text	
32K/cassette		84 keys, 12-key keypad	serial, parallel		
8K/cassette	memory expands, CRT/cassette				
2K		65-key mini-keyboard	N/A	24-character LCD	
4K		65-key mini-keyboard	N/A	24-character LCD	
4K/cassette	joysticks, Videotex pak, modem, appliance control	53 button-type keys	serial,	256 × 192, 8 colors, 32 × 16 text	
4K		65 keys, 12-key keypad	parallel	64(32) × 16 text	integral display
16K/cassette		65 keys, 12-key keypad	parallel	64(32) × 16 text	integral display
16K/cassette		standard	serial	16 colors	
16K/cassette		standard	serial	16 colors	

Texas Instruments

It is into this area that the name of another giant of the industry enters. Texas Instruments. It recently enhanced its *TI-99/4* home computer into the *TI-99/4A*.

The basic *TI-99/4A* is driven by a Texas Instruments 16-bit TMS9900 CPU, as is the *TI-99/4*. No, that's not a typographic error—TI uses a powerful 16-bit microprocessor in its home computers and has finally unleashed some of the potential power of that processor in the enhanced machine.

One of the early criticisms raised about the *TI-99/4* was that, although a 16-bit processor was used, computerists couldn't access its potential power. The reason was that all of the programming was ROM-resident, and inaccessible to the potential programmer. There was no way for an individual user to work in machine language, and no way to save high-level language programs except on cassette. Unfortunately, that is still true to a great extent. Most of the programming for TI's home computer is still ROM-based in the form of cartridges, but now, at least, a disk-based editor/assembler allows you to write machine-language programs.

What does the \$525 basic keyboard unit contain? It contains the CPU and 16K of RAM. There is also a substantial amount of ROM that contains the TI operating system and BASIC.

In a more powerful version of this system, a user can link BASIC and machine-language for direct access to tech system features. That is done by using the call commands *LOAD*, *LINK*, *PEEK*, *POKE V*, *PEEK V*, and *CHARPAT*. Thus, a user can call machine-language subroutines and expand his computing power.

The basic unit contains the connector needed to support system expansion, but it must be initialized and driven by a separate RS-232C card.

It also contains the 48-keyboard and cartridge connector. The keyboard has 6 dual-function keys that are accessed via a *FUNCTION* key.

Commodore

Commodore Business Machines has two more entries in this price category, the *P128* and the *64*, at \$595 and \$995, respectively.

Although it resembles the *VIC 20*, the Commodore *64* is a far more powerful machine. For starters, it has 64K of RAM and can handle programs written for the Commodore *PET* series of computers through the use of a *PET* emulator.

The basic unit includes a 65-key keyboard and an 8-bit 6510 CPU (which is like the 6502 pioneered by CBM, but which has more I/O lines). The *64* is capable of using all of the *VIC 20* peripherals, which is very convenient if you've invested in the *VIC 20* and are upgrading to the *64*.

The *64* can generate 64 characters and 256 moveable sprites (graphics elements). It is also capable of screen magnification



THE BASIS FOR A POWERFUL SYSTEM, the Radio Shack *TRS-80 Model III* can be purchased for as little as \$699.



AMONG THE ADVANTAGES of the Radio Shack *TRS-80* family of computers is the wide range of peripherals available for them, such as the printer shown here.

(doubling the size of the display), and the display is memory-mapped, which enables you to place picture elements on the screen according to their memory locations (each screen-memory location in a memory-mapped system corresponds to a specific position on the display). This is a handy feature for computer-driven graphics.

The computer can be connected to other peripherals through either a parallel or serial port.

The *P128* is a far more powerful system. Driven by an eight-bit 6509, it has been called the third-generation *PET* series by the company. It connects directly to a television set via a built-in RF modulator.

The power of the *P128* becomes apparent when you consider the amount of built-in RAM, 128K. That is more than enough to handle almost any function, program, or language. The computer's power is also evident from its graphics capabilities. It can generate 16 colors, and the screen resolution is 320 by 200 pixels, which means high-level graphics. The standard alphanumeric display is 40 by 24 lines.

The standard language is still *PET* BASIC.

Again, this is only the starting level of this system. A Z80 board can be added for access to CP/M, and there is a variety of printers and disk options available for it.

One last comment about the keyboard: it includes 10 user-definable special function keys. This is *in addition* to the graphics capabilities of these keys.

CBM also has another entry in this price range, the *PET 4016*. At \$995, this 16K basic computer has graphics capabilities built into its keyboard and, like the *P128*, it also has a numeric keypad built into its keyboard for quick data entry. It is driven by an eight-bit CPU.

Imsai

As noted earlier, not all home computers come equipped with the familiar CRT, keyboard, and cassette or disk drives. Some of them are, little more than the heart of a system—an enclosure, motherboard, CPU board (sometimes), and power supply—to which you have the option of adding your own memory and peripherals.

One such system is offered by Imsai. It is a totally bus-oriented system to which the user adds whatever boards and peripherals will best suit his needs. As such, it offers an enormous amount of flexibility and potential for expansion.

Available either as a kit—the *I-8080K* at \$599—or as an already-assembled unit—the *I-8080* at \$799—the *8080* uses an eight-bit 8080 (an 8085 can be supplied as an option). The standard *8080* comes with a 22-slot S-100 motherboard and a 28-amp power supply—enough to support a very powerful system, and Imsai offers a number of options which we'll discuss later. No memory is included in the base price, but it is readily available from Imsai and from other manufacturers of S-100 bus products.

An important *8080* feature is its front panel. With its paddle switches and LED's, it makes the computer the idea tool for data

acquisition and process control in areas where a dedicated device is required—and where a terminal and other peripherals would be wasted. The front panel can even be used for machine-language programming, if desired.

Furthermore, the front panel is an invaluable debugging tool. You can work your way through a program step-by-step and see which data, address, and control lines are active at any point. For the experienced programmer, this feature can be more useful than a software debugging-program.

Finally, the front panel can be used to evaluate and debug S-100 hardware, such as interface or memory boards. A memory-test program may tell you which part of memory is bad, but the front-panel LED's will show you exactly what is—and isn't—happening.

The beauty of this type of system is its expandability. Since the system card cage has so many slots (board connectors), a user has many installation choices. He can install more memory via 32K and 64K—or larger—RAM cards or he can install a disk-controller board and, with CP/M, can run any number of languages and programs.

A faster system offered by the same manufacturer, the *I-8085*, is available for \$950. It is identical to the *8080*-series except for the fact that it uses an eight-bit 8085 CPU, rather than the 8080.

The Imsai *PCS-8015*, available for \$750 (less memory), is similar to the *I-8085*, but has no front panel. It is well suited for use in a turnkey business system.

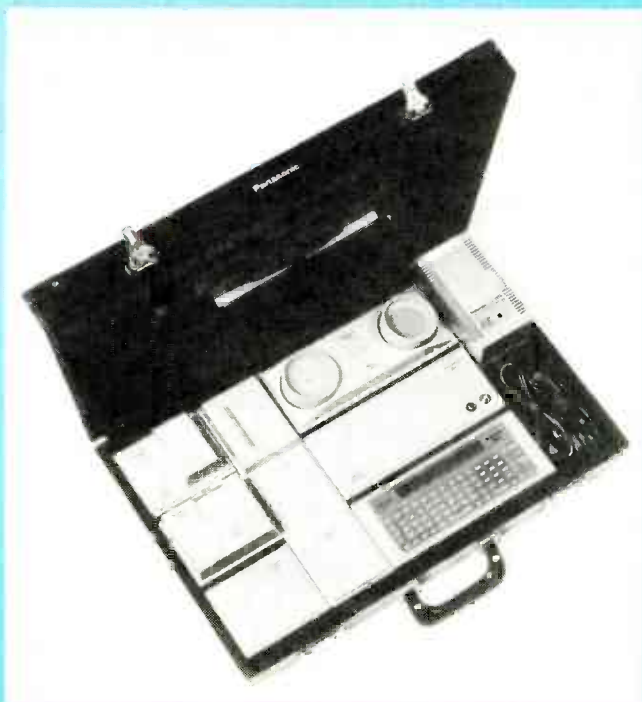
Formula International

One segment of the market which seems to be generating a great deal of controversy is the *Apple II*-like computer. There is one in the \$1,500 to \$2,000 price category, and there is one in this segment of the market, too, called the *Pineapple*.

Offered by Formula International, it is a kit which must be put together. The CPU is an eight-bit 6502, like the one in the *Apple II* itself, and it is compatible not only with the *Apple II* operating system, but also with its peripherals and programs. (This was confirmed by a spokesman for Formula International.) The price of the *Pineapple* is \$645.

M/A COM OSI

M/A-Com-OSI also has an entry in this price category, the *C/P*. It uses a 6502 CPU and includes a full keyboard.



SYSTEMS IN A BRIEFCASE, the Panasonic hand-held computers can be upgraded to form a complete, portable, computer system.



Like other types of keyboard computers, this one, offers both alphanumeric and graphics video displays. The display can be set up as either 24 by 24 or 12 by 48. The computer includes a cassette interface and a serial port for use with a modem or printer. This \$565 machine comes standard with 8K or RAM.

Atari

Another keyboard-computer is the \$899 Atari *800*. Unlike its less-expensive relative, the *400*, this one sports a typewriter-style keyboard, rather than a membrane type.

Driven by an eight-bit 6502B CPU, the Atari *800* features 16K or RAM as standard and includes a 10K ROM operating system. BASIC is supplied in the form of a plug-in ROM pack.

The system is quite powerful. The computer can generate inverse video (as can most other systems on the market) and offers full screen editing. The basic system includes a built-in RF modulator that will turn any television set into a display for the computer. When connected to a color receiver, the *800* can display 16 colors in 16 intensities. It also features four independent sound-synthesizers for musical tones or game sounds. They cover four octaves, and there is internal volume control for each one.

The display, which has a resolution of 320 columns by 192 rows for graphics work, will display three text modes: 40 by 24 lines, double-width, and double-height characters. There are also *nine* graphics modes.

The power of the Atari *800* system is demonstrated by its BASIC. Atari BASIC is an 8K floating-point language with 9-digit precision. The BASIC interpreter allows access to both the graphics and sound features of the computer, and allows calls of machine-language subroutines. The user has access to memory and its contents through the PEEK and POKE commands. Also available is a more powerful Microsoft BASIC. It offers a greater range of commands and has 14-digit floating-point accuracy. The disk-equipped version of this system with 32K of RAM is required for this option.

Other languages and programming aids available include PILOT, an assembler/editor, a macro assembler, and a program text editor.

Cromemco

Rounding out this price category is the *System Zero* at \$995, from a manufacturer known for business systems, Cromemco.

Using a Z80A with a speed of 4 MHz, that single board computer with three expansion slots is the basis of a powerful system. It comes with 64K of RAM, although all peripherals are extra. Since it is an S-100-bus computer, it can be expanded greatly using boards from Cromemco or other manufacturers.

Though this rounds out our look at specific systems in this category, remember that most of the inexpensive systems mentioned in the previous category, like the *Explorer 85*, can easily reach this price level when peripherals are added. R-E

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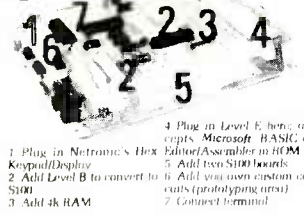
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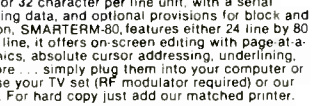
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GLOSSARY OF COMMONLY USED COMPUTER TERMS

For those readers unfamiliar with computer terminology, we have included the following glossary of some commonly used computer terms.

Address—The label or number identifying the register or memory location where a unit of information is stored.

Applications software—Software written to do a specific job, such as solve a mathematics problem, play a game, etc. See **systems software**.

ASCII BASIC—Acronym for American Standard Code for Information Interchange. A seven-bit code used to represent alphanumeric characters. It is useful for such things as sending information from a keyboard to the computer.

Assembly language—A machine oriented language in which mnemonics are used to represent each machine-language instruction. Each CPU has its own specific assembly language. See **CPU** and **machine language**.

Binary—Refers to the base 2 number system in which the only allowable digits are 0 and 1.

Bit—Acronym for *Binary digit*. The smallest unit of computer information, it is used to represent either a binary 0 or 1.

Bootstrap—A program that starts the computer and prepares it to load other programs into memory.

Bus—Parallel lines used to transfer signals between devices. Computers are often described by their bus structure (i.e.—S-100-bus computers, etc.).

Byte—A group of eight bits.

CPU—Acronym for *Central Processing Unit*. The part of the computer that contains the circuits that control and perform the execution of computer instructions.

Data base—A large amount of data stored in a well-organized manner. A data-base management system is a program that allows access to the information.

Disk—A circular device with a magnetic surface used to store data, programs, etc. Floppy (flexible) disks can store between approximately 100 to 1000 kilobytes, depending on their size (5¼ or 8 inches), recording density and whether both sides of the disk are used. Hard (rigid) disks can store upwards of 5 megabytes.

Disk operating system—Program used to transfer information to and from a disk. Often referred to as a DOS.

EPROM—A PROM that can be erased by the user, usually by exposing it to ultraviolet light. See **PROM**.

File—A collection of data that is treated as a unit.

Hardware—The physical components that make up a computer.

Hexadecimal—Refers to the base-sixteen number system. Machine language programs are often written in hexadecimal notation.

Machine language—Instructions, written in binary form, that a computer can execute directly. Also called machine code or object code.

Microprocessor—A one-IC CPU. One common microprocessor often used in personal computers is the Zilog Z80.

Modem—Acronym for *MOdulator/DEModulator*. A device that transforms electrical signals into audio tones for transmission over telephone lines, etc.

Octal—Base-eight number system.

PROM—Acronym for *Programmable Read Only Memory*. A semiconductor memory whose contents cannot be changed during normal computer operations, but that can be programmed under certain special conditions.

RAM—Acronym for *Random Access Memory*. A semiconductor memory that can be both read and changed during computer operation. Unlike other semiconductor memories, this one is volatile—if power to the RAM is cut-off for any reason, all data stored in the device is lost.

Register—A storage location inside the CPU.

ROM—Acronym for *Read Only Memory*. A semiconductor memory containing fixed data—the computer can read the data but cannot change it in any way.

Software—programs.

System software—Software that governs the computer's operation or aids in developing other programs.

Word—Number of bits that are treated as a single unit by the CPU. In an eight-bit machine, the word length is eight bits; in a sixteen-bit machine, it is sixteen bits.

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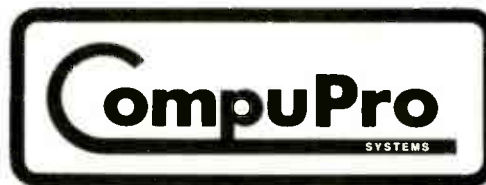
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IT'S STILL AMAZING TO MANY PEOPLE THAT SO MUCH COMPUTING power can be purchased as inexpensively as it can. As we saw in the first part of this survey, there's quite a lot of power packed into personal computers that are priced under \$1000. This also holds true between \$1000 and \$1500.

Apple

The *Apple II* and *Apple II+*, with eight expansion slots, are the basis for a very powerful home or business system, indeed. For a base price of \$1330 (for either version of the computer—the main difference between the two is in the mathematical

capabilities of their BASIC's) you can start with a 6502-based machine with 16K of RAM, expandable to 64K. Both can generate color or black-and-white graphics, with a maximum resolution of 192 by 280 (192 by 140 in color) and include D/A converters for game paddles or other external devices.

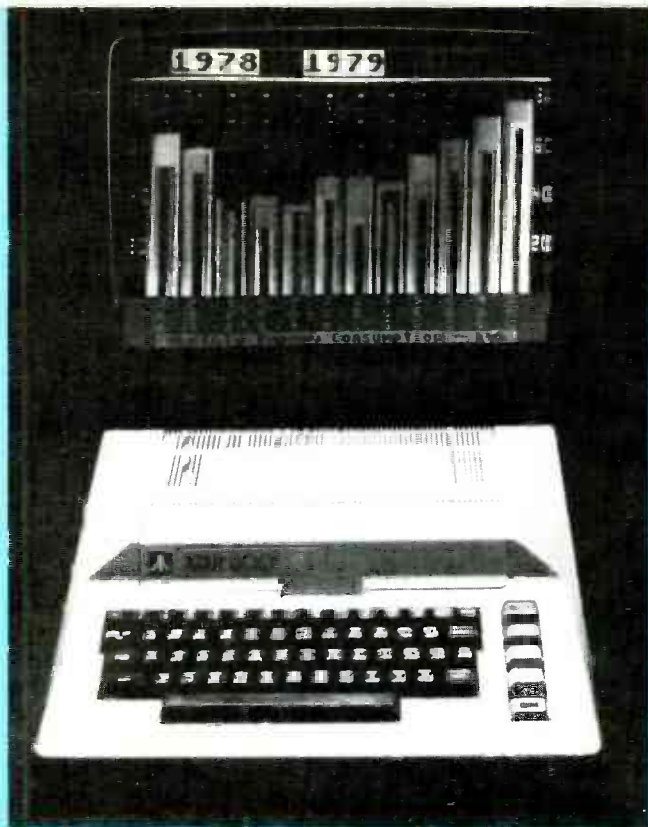
We'll cover the Apple computers much more thoroughly later on.

Texas Instruments

Look at the Texas Instruments *TI-99/4A*. It is driven by a 16-bit CPU, the TMS-9900. Quite a bit of power is locked into

TABLE 3—\$1000-\$1500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple II, Apple II+	\$1330	6502	8 bits	N/A	BASIC
Atari Home Computers 1192 Borregas Sunnyvale, CA 94086	Atari 400	\$1172	6502B	8 bits	N/A	BASIC, assembly, Pilot
Atari Home Computers	Atari 800	\$1294	6502B	8 bits	N/A	BASIC, assembly Pilot
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	VIC 20	\$1293	6502	8 bits	proprietary	BASIC
Commodore Business Machines	Commodore 64	\$1065	6510	8 bits	N/A	BASIC
Commodore Business Machines	Commodore 64	\$1194	6510	8 bits	proprietary, CP/M(optional)	BASIC
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI, C1P	\$1465	6502	8 bits	N/A	BASIC
M/A COM OSI	OSI C4P	\$1025	6502	8 bits	N/A	BASIC
NEC Home Electronics 1401 W. Estes Ave. Elk Grove, IL 60007	PC-8001	\$1205	uPD 780 c-1	8 bits	N/A	BASIC, COBOL, FORTRAN, Pascal
Panasonic 1 Panasonic Way Secaucus, NJ 07094	RL-1000	\$1103		8 bits	N/A	BASIC
Panasonic	RL-1400	\$1203		8 bits	N/A	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Color Computer	\$1002	6809	8 bits	N/A	BASIC
Radio Shack	TRS-80 Color Computer	\$1401	6809	8 bits	N/A	BASIC
Radio Shack	TRS-80 Model III	\$1196	Z80	8 bits	N/A	BASIC
Sony 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$1475	Z80A	8 bits	N/A	BASIC
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$1373	TMS9900	16 bits	N/A	BASIC editor/ assembler



HARDWARE

\$1000-\$1500

this unit. The software for the computer is supplied by TI on ROM (Read Only Memory) cartridges. The software that is available includes BASIC, the high-level programming language.

In this price range, the user has a pretty good home system. For \$1373, using a cassette recorder for mass storage, the user has access to not only network communications—The Source, Comp-U-Serve, etc.—through the RS-232C interface and software, but the user also gains color capabilities through the high-resolution color monitor. Hard copy is available with a

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/cassette interface		standard		40 × 24 text, up to 192 × 140 graphics	
16K/cassette		57 keys, membrane	serial, parallel	40 × 24 text, up to 320 × 192 graphics	printer RS-232C
16K/cassette		61 keys, 4 special-function	serial, parallel	40 × 24 text, up to 320 × 192 graphics	printer
5K/5¼-inch floppy disk		66 keys, 4 user-programmable	serial, IEEE-488	22 × 23 text, 176 × 184 graphics	
64K/cassette interface		64 keys, 4 user-programmable	serial	40 × 25 text, 190 graphics characters	printer
64K/5¼-inch floppy disk		64-key, 4 user-programmable	serial	40 × 25 text, 190 graphics characters	
8K		standard	serial	24 × 24 or 48 × 12 text	
19K				32 × 64 text, 256 × 512 graphics	
32K/cassette interface	mcni-or	84 keys, 12-key keypad	serial, IEEE-48	80 × 25 text, 160 × 200 graphics	12-inch green monitor
2K	RS-232C, video package	65-key mini-keyboard	serial	16 × 32 text, 48 × 64 graphics	Video/RF adapter
4K	RS-232C, video package	65-key mini-keyboard	serial	16 × 32 text, 48 × 64 graphics	Video/RF adapter
16K/cassette interface	16K, printer	53 button-type keys	serial	8 colors, 192 × 256 graphics	
16K/cassette interface	16K, printer	53 button-type keys	serial	8 colors, 129 × 256 graphics	12-inch color CRT
4K/cassette		65 keys, 12-key keypad	parallel, serial	12-inch B&W, 64 (32) × 16 text	printer
64K/cassette interface		72 keys, 5 programmable	serial, parallel		
cassette		standard		32 × 24 text, up to 192 × 256 graphics	printer, RF Adapter, 10-inch color CRT

solid-state printer. Please refer to the previous discussion for a full description of the basic system.

NEC

The buyer and user of the NEC *PC-8001* will also have a pretty powerful home computer system.

This system includes 32K of RAM and a 12-inch green phosphor monitor, but uses a cassette recorder for mass storage. All of this comes in a package that costs \$1205.

Panasonic

Handheld computers can gain a lot of power through expansion and these appear in this price range. The price of the Panasonic *RL-1000* rises to more than \$1000 with just the addition of communications capability and video display capability. For \$1103, the 2K version can be equipped with serial communications ability via an RS-232C package. It also gains the capability for interfacing with a video display with the inclusion of a video-RF package. The more powerful 4K RAM *RL-1400*, with the same capabilities, has a price of \$1203.

Radio Shack

When the *TRS-80 Color Computer*, also using a cassette recorder system for mass storage, is configured as a "student" system, its cost rises to \$1002. This system includes 16K of RAM, Extended Color BASIC, and line printer, but the user must provide his own color monitor. These additions drastically increase the capabilities of this system. And, if the user opts for the Radio Shack monitor, the price of the complete package rises to \$1401.

Atari

Both Atari systems, the *Atari 400* and the *Atari 800*, have configurations that appear in this price range. When the *Atari 400* is equipped with communications capability via the complete communications package (including modem and communications software), and with printer capability, its cost rises to \$1172.50. A standard TV receiver is used for display purposes. The same is true of the more expensive *Atari 800*.

However, the *800's* capabilities aren't as great in this price segment. When equipped with only a printer, the price of the *Atari 800* rises to \$1294. It has no communications ability. Both systems, incidentally, use cassette mass storage in this price range.

Commodore

Even the small *VIC-20* system takes on some very sophisticated capabilities in this price range. When a user equips this system with a 5¼-inch minifloppy disk drive for mass storage, gives it communications capability with the addition of the RS-232C serial package, and gives it hard-copy output capability with the addition of a printer, then the price of this expanded system rises to \$1403.

The *Commodore 64*, is compatible with all the *VIC-20* periph-



POTENTIALLY A POWERFUL SYSTEM, the price of the base *Apple II* from Apple falls in this range.

eral equipment. After all, both systems are made by the same manufacturer and both are in the same relative price range, so one can expect this to be true. So, when the *Commodore 64*, which comes with 64K of RAM, is equipped with a cassette recorder for mass storage and a printer for hard copy output, the price of this system rises to \$1065. If you equip this system with a 5¼-inch minifloppy disk drive for mass storage, but delete the printer, then the price of this system rises to \$1194.

Radio Shack

Another system that begins its upgrading in this price spectrum is the *TRS-80 Model III*. The "Starter" system, which includes 4K of RAM and a line printer, but uses a cassette recorder for mass storage, is priced at \$1196. The *TRS-80 Model III* is a Z80-driven all-in-one personal computer that combines the CRT, keyboard, and CPU into one terminal-like housing.

M/A-Com-OSI

M/A-Com-OSI has two entries in this price range. The *C4P*, the starting point of many of this company's systems, is priced at \$1,025. That system, as with all of this company's other systems, use a 6502 microprocessor.

That price will bring the user 19K of memory as standard and disk storage capability. Built into this system are the needed video outputs, plus interface capabilities for either a modem or printer.

The system language of the *C4P* is a BASIC interpreter. The operating system for this machine is the company's proprietary OS-65D.

The second system offered by M/A-Com-OSI is the more complete *C1P-MF-20K*. Costing \$1465 and driven by the same type of processor, this system features a full built-in keyboard and 8K of RAM. This system, programmable in BASIC, can be expanded to include dual, minifloppy disk drives and 32K of RAM. This system includes interface capabilities for a printer, cassette and CRT.

Sony

Not all the systems appearing in this price range are only system upgrades, some are the foundation upon which very powerful systems will be built in the higher price categories.

The *Sony SMC-70*, which eventually becomes a very powerful system as it moves through our pricing categories, has its roots here at \$1475.

The *SMC-70* is another of the keyboard-computers on the market. In this form, it includes nothing more than the keyboard and computer with 64K of RAM. As you can see, it's a powerful system from the start. It is driven by a high-speed Z80A processor with clock speed of is 4.028 MHz. Though the high-level language Sony BASIC, this system will also recognize and run the industry standard CP/M operating system. This is an attractive feature because it puts many CP/M-based software packages at the user's fingertips.

R-E



THE *SMC-70* from Sony is supplied with 64K of RAM memory. It is shown here with optional 3.5-inch disk drives and RS-232C interface.



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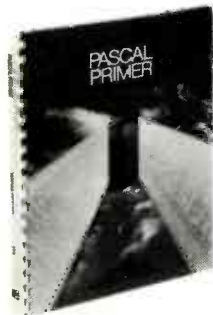
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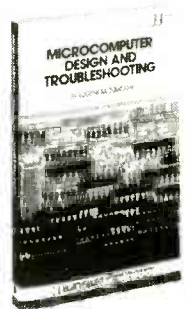
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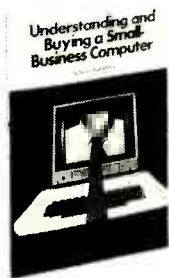
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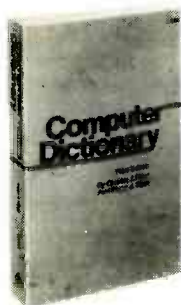
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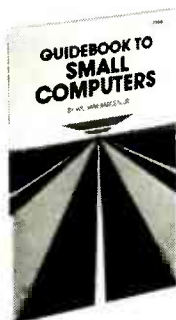
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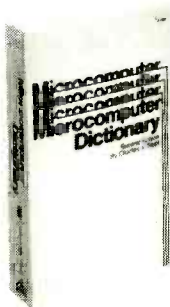
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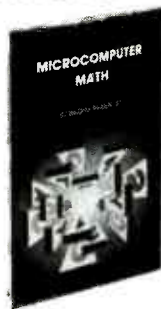
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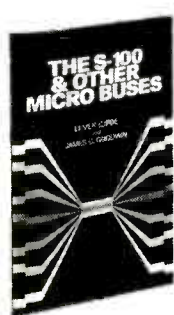
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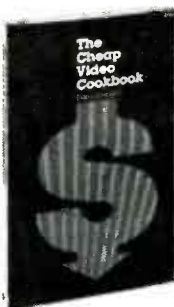
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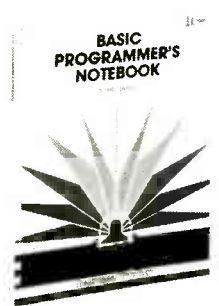
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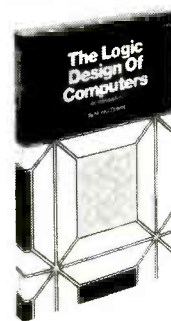
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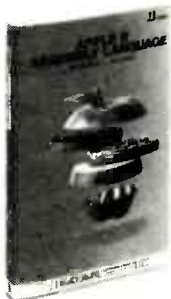
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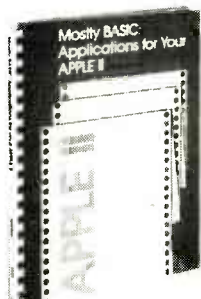
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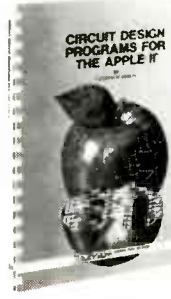
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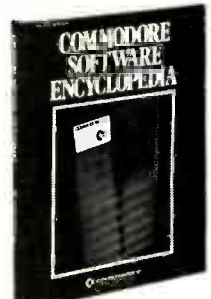
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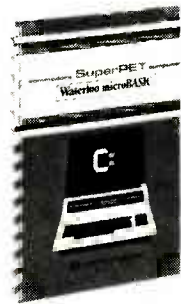
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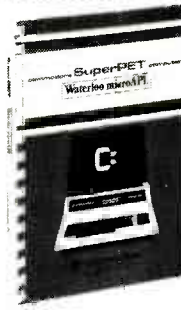
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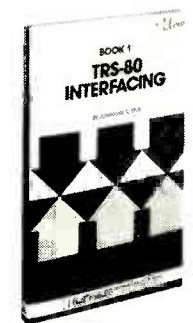
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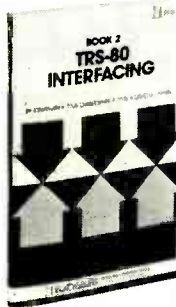
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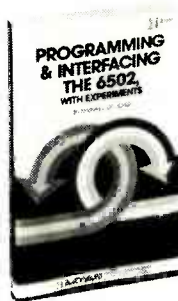
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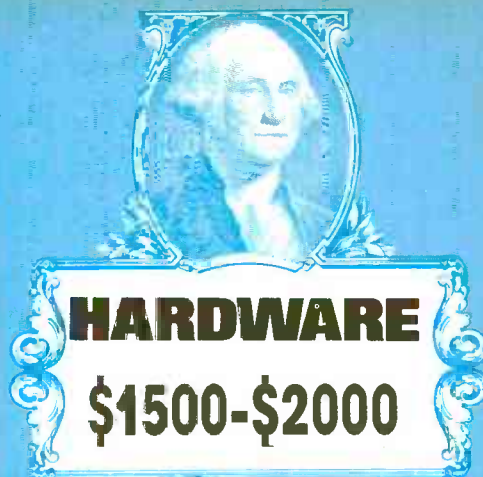
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MARC STERN

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It is in this area, though, that some very powerful systems have their origins and some very powerful computer firms enter the competition. It is also here that lower-end computer systems begin to stretch their legs.

The name IBM first makes its appearance here with its \$1565 *Personal Computer*. Yes—IBM sells a computer for less than \$1600.

In its standard configuration, the *Personal Computer*, or *PC*, consists of a 16-bit, 8088-based computer with 16K of RAM. In this entry-level version, it is possible for a user to load and save BASIC programs using a cassette recorder. Those programs are entered through an 83-key detachable keyboard, which also has a 10-key keypad for rapid data entry, and 10 function keys.

The system has 40K of ROM, which contains the operating system, BASIC, and instructions for performing complex graphics functions. It can generate 16 foreground colors and eight background colors. There is also a built-in speaker for sound generation.

The *Personal Computer PC* is a modular unit, and a user is able to expand it extensively in building-block fashion, as we shall see later.

Olivetti

Another noted equipment-manufacturer has also entered the personal/home/business-computer field—Olivetti, with its *M-20*. This microcomputer is also a modular unit.

What you get for an investment of \$1988 is a 16-bit machine, driven by a Z8001 microprocessor. This is one of the first personal computers on the market to make use of this powerful CPU.

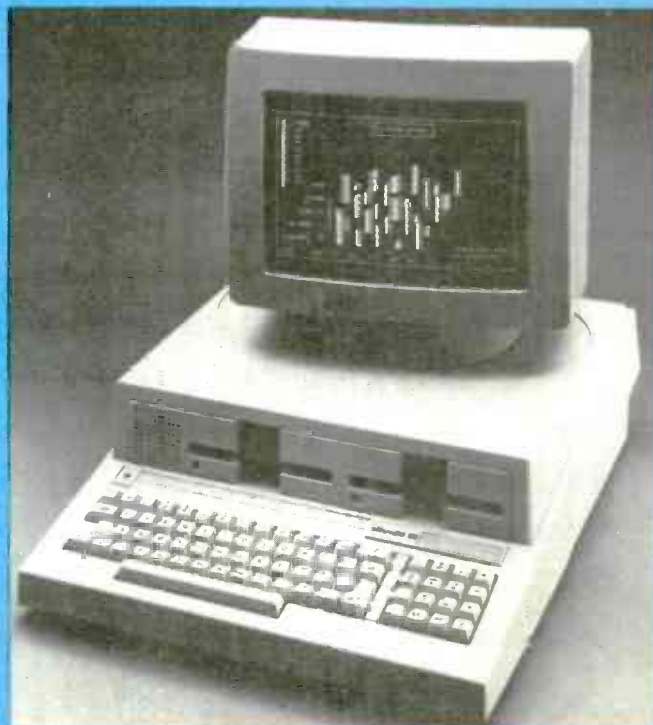
What's the attraction of a 16-bit over an 8-bit CPU? One of the key answers is speed. A 16-bit CPU can access data and process it much more quickly than an 8-bit processor (see the separate piece on 8-bit vs. 16-bit computers in this section). Sixteen-bit machines also tend to run at fairly high speeds, and the *M-20* is no slouch in that department.

Straight out of the carton, this is a powerful unit, even with

few peripherals attached. To give one example, it comes already equipped with 128K of RAM.

The computer runs Olivetti's proprietary PCOS and recognizes only programs written under that operating system. The use of a proprietary operating system can be a drawback for the potential user because, unless he opts for the CP/M emulation disk, which will allow him to run CP/M 2.2, or the soon-to-be-available soft card, which will allow him to run CP/M or MS-DOS, he will be limited to programs written specifically for this computer.

The BASIC language in this machine is the powerful BASIC



THE *M-20*, from Olivetti, is one of the first personal computers to use the powerful Z8001 16-bit microprocessor.

80 and the computer is capable of 256 commands and functions. Memory is expandable to 512K through the use of plug-in expansion boards; there are five slots on the motherboard for this and other purposes.

The display capabilities of the M-20 are very good. It can display either 80 by 25 lines or 64 by 16. The resolution level for a color monitor is 512 by 256 pixels, which makes this machine capable of high-level graphics.

PCOS is a powerful operating system for the computer's dual quad-density floppy-disk system. PCOS monitors and manages the total system's resources. Not only does it catalogue and

execute commands and procedures, but it also executes the system utilities and calls machine-language routines. It can also provide security for data via passwords and can "window" the display so only a small portion can be viewed at a time.

Micro Technology Unlimited

Micro Technology Unlimited's MTU-130 uses a 6502 microprocessor and comes with 80K of built-in RAM.

It is a truly modular system that begins with little more than the system box and 96-key keyboard. In that configuration, external data and program storage is provided by a cassette recorder.

TABLE 4—\$1500 -\$2000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple II	\$1530	6502	8 bits	N/A	BASIC
Atari Home Computers 1265 Borregas Sunnyvale, CA 94086	Atari 800	\$1552	6502	8 bits	N/A	BASIC
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	Commodore B128	\$1695	6509	8 bits	proprietary	BASIC
Commodore Business Machines	CBM 4032N	\$1295	6502	8 bits	N/A	BASIC
Commodore Business Machines	CBM 8032B	\$1495	6502	8 bits	N/A	BASIC
Commodore Business Machines	Commodore 64	\$1589	6510	8 bits	proprietary	BASIC
Commodore Business Machines	CBM 8032N	\$1995	6502	8 bits	N/A	BASIC
Commodore Business Machines	SuperPET SP9000	\$1995	6809/6502	8 bits	N/A	APL, BASIC, Pascal, FORTRAN, COBOL assembler
Commodore Business Machines	CBM 4016	\$1690	6502	8 bits	proprietary	BASIC
Franklin Computer Corp. 7030 Colonial Hwy. Rennsauken, NJ 08109	Ace 1000	\$1595	6502	8 bits	N/A	BASIC
Heath Co. Benton Harbor, MI 49022	H-89	\$1895	Z80	8 bits	HDOS, CP/M (optional)	BASIC, other CP/M compatible
International Business Machines Box 1328 Boca Raton, FL 33432	IBM Personal Computer	\$1565	8088	16 bits	N/A	BASIC
MicroTechnology Unlimited , Box 12106 Raleigh, NC 27605	MTU 100	\$1549	6502	8 bits	N/A	
MicroTechnology Unlimited	MTU	\$1699	6502	8 bits	N/A	
MicroTechnology Unlimited	MTU 130	\$1999	6502	8 bits	N/A	
Netronics Research 333 Litchfield Rd. New Milford, CT 06776	Explorer 85	\$1530	8085	8 bits	CP/M	CP/M compatible
Non-Linear Systems 533 Stevens Ave. Solana Beach, CA 92075	Kaypro II	\$1795	Z80	8 bits	CP/M	SBASIC
Olivetti Corp. 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$1988	Z8001	16 bits		BASIC
Osborne Computer 26500 Corporate Ave. Hayward, CA 94545	Osborne I	\$1795	Z80A	8 bits	CP/M	CBASIC, MBASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Color Computer	\$1601	6809	8 bits		BASIC

The *MTU-140's* operating system is the called CODOS, and it recognizes UCSD-p-System Pascal, the high-level FORTH language, BASIC, and supports an assembler. The video display is bit-mapped which makes complex graphics relatively easy. Input and output are via two parallel ports and a serial port.

The *MTU-130* can be upgraded while still staying within this price range by adding a 12-inch green-screen CRT (the base price is \$1549; the monitor increases that to \$1699).

Franklin

A computer in this category that is the subject of much

controversy is the Franklin *ACE 1000*. At \$1595 it isn't much more expensive than the *Apple II...* and it's another of the *Apple* look-alikes.

The *ACE 1000* comes equipped with 64K of RAM. Its typewriter-style keyboard has 72 keys, and there is also a 12-key keypad for number entry. Because of its resemblance to the *Apple*, it is reasonable to assume that hardware and software for that computer will also work in the *ACE 1000*.

Heath/Zenith

Heath/Zenith also has an offering in this price category, the

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/cassette		53 keys	serial	40 × 24 text, 280 × 192 graphics	
16K/cassette		61 key, 4 special function	RS-232C interface		printer
128K/dual 5¼-inch double-density floppy disk		92-key keyboard, 10 user-programmable keys, 19-key keypad	IEEE-488, serial	80 × 25 text, up to 320 × 200 graphics	integral display
32K/cassette		standard, numeric keypad	IEEE-488	40 × 25	integral display
32K/cassette		standard, numeric keypad	IEEE-488	80 × 25	integral display
64K/5¼-inch floppy disk		64 keys, 4 user-programmable	RS-232C interface	40 × 25 16 colors	printer
cassette		standard, numeric keypad	IEEE-488	80 × 25	integral display
96K/cassette		standard, numeric keypad	IEEE-488	80 × 25	integral display
16K		standard, numeric keypad	IEEE-488	40 × 25	integral display
64K/cassette		72 keys, 12-key keypad		40 × 24 text, 280 × 192 graphics	Apple-compatible
48K/5¼-inch floppy disk		84 keys, 12-key keypad	3 serial, 1 parallel	80 × 25	integral display
16K/cassette		83 keys, 10 key keypad, 10 special-function keys	serial, parallel	80 × 25 text, up to 640 × 200 color graphics	
80K/cassette		96 keys	2 parallel, 1 serial		terminal only, upgradable
80K/cassette		96 keys	2 parallel, 1 serial	12-inch	green CRT, terminal only, upgradable
80K/disk controller only		96 keys	2 parallel, 1 serial		12 inch green CRT, terminal only, upgradable
32K/8-inch floppy disk			serial		
64K/dual 5¼-inch double-density floppy disks		62 keys, 14-key keypad	serial, parallel	80 × 24	9-inch integral green CRT
128K/cassette		72 keys	parallel serial	80 × 25, up to 512 × 256 graphics	
64K/dual 5¼-inch floppy disk		81 keys, 10-key keypad	serial, parallel		5-inch integral CRT
16K/5¼-inch floppy disk		53 keys, button-type	serial	32 × 16 8 colors, 192 × 256 capability	

entry-level *H-89* (from Heath)/*Z-89* (from Zenith). Like the Radio Shack *TRS-80 Model III*, this all-in-one unit houses the CRT, keyboard, CPU, and 48K of RAM. At \$1895 as a kit from Heath, it's quite a bargain. Fully assembled and tested, it is called the *Z-89* and costs about \$1,000 more.

The computer uses two Z80 microprocessors—one for computing purposes, and the other to handle display functions. The second Z80 allows the first to perform its task more efficiently. The *H/Z-89* comes with an 84-key keyboard that includes a 12-key keypad.

Also included is a single 5¼-inch disk drive. The operating system is Heath's own HDOS, but the computer can also run CP/M, which opens the door to a wealth of software.

Although a black-and-white CRT is standard, an anti-glare green (or black-and-white) one is available for an additional \$30. The display is 80 by 24, with an optional 25th status line. There are also three RS-232 serial ports to allow the connection of a printer, modem, etc.

Commodore

Commodore Business Machines also has a number of computers in this price class. For instance, we find the 32K *PET 4032N*. It features a built-in 12-inch, 40 character display, and includes a keyboard with both alphanumeric and graphics characters, and numeric keypad. With a single disk drive, the system sells for \$1695; without, it sells for \$1295.

Also in this price range is the Commodore *64* which, with a dot-matrix printer and a single floppy-disk drive costs \$1,589. Another entry is the \$1500 *CBM 8032B*, which features a typewriter-style keyboard, numeric keypad, built-in CRT with an 80 column by 25-line display, and 32K of RAM. ROM-based BASIC 4.0 is also standard.

Like all CBM machines, the \$1695 *B128* uses an 8-bit microprocessor—in this case a 6509. The Commodore "B"-series computers are aimed at the business market and this one comes with 128K of RAM—more than enough memory for just about any business application. It is another of Commodore's all-in-one machines and, as such, includes an integral 80-column by 25-line CRT.

While the computer uses Commodore's own DOS, CP/M can be run by adding a plug-in card option.

Osborne

An interesting phenomenon in this segment of the microcomputer market is the all-in-one, truly portable unit. One such is the *Osborne 1*, which carries a pricetag of \$1795.

What sets this system apart from the others we've discussed so far is that there is no need to purchase either peripherals or add-on software. A CRT and dual 5¼-inch floppies are built in, and a comprehensive software package is included (see below).

If the name "Osborne" sounds familiar, it should. Adam Osborne is one of the wizards of the microcomputer revolution and not only manufacturers computers, but has also for a long time been a successful author and publisher of articles and books



THE COMMODORE "B" series of personal computers, such as the *B128*, are aimed primarily at the business market.

on microcomputers and the microcomputer industry. Apparently, what Osborne felt the world was ready for was a low-priced, full-service computer, so he developed the *Osborne 1*.

A CP/M-based unit the computer weighs only 23 pounds and is small enough to fit under an airline seat. For truly portable field use, it can't be beat. Not only does it have built-in dual 5¼-inch, single-density floppy disks—there is a double-density option available for increased mass storage—but it also comes with a powerful software package that includes *WordStar/MailMerge*, *Supercalc*, *MBASIC*, and *CBASIC-2*.

Each single-density floppy can hold 100K, and there is a 5-inch high-resolution CRT. That CRT is excellent for field work, but for home or office use you might be better advised to purchase the optional 9-inch green-phosphor monitor. The full 81-key keyboard has a 10-key keypad for quick numeric data entry. The *Osborne* also has an IEEE-488 port (popularized by Hewlett-Packard and used by Commodore) for interfacing with test equipment.

Perhaps the most important thing about this system is its completeness. With it, a user really has little need of anything else, save, perhaps, a printer. In fact, some observers have said that what a buyer gets when he puts down his money is the software—hardware is free.

Non Linear Systems

The \$1795 *Kaypro II* is quite similar to the *Osborne 1*. Its manufacturer, Non Linear Systems, is noted for its test equipment and is a newcomer to the computer field.

The key difference between this and the Osborne unit is the size of the display—9-inches is standard—and the mounting of the disk drives (vertically, rather than horizontally).

Like the Osborne machine, the *Kaypro II* uses a Z80A microprocessor and is CP/M-based. It has two single-sided, double-density 5¼-inch disk drives, and, like the Osborne, has a serial port for peripherals.

Instead of using *WordStar* for word processing, Non Linear Systems has opted for *Select*, and also includes a spelling checker, *SuperSpeller*. *MBASIC* is also among the software supplied.

The success of the *Osborne 1* indicates that a market exists for such a system and the arrival of the *Kaypro II* shows that



A FULL FEATURED, truly portable computer, the *Kaypro II* from Non Linear Systems features a nine-inch display.

manufacturers are filling the void. There are sure to be more computers of this sort to come.

Upgrades

This sector of the price spectrum also contains various system upgrades. For instance, Radio Shack's *TRS-80 Model III* is available for \$1995 with one 5¼-inch disk drive and 48K of RAM.

Even the *Explorer 85* is here, in its near-fully configured state with the addition of a floppy disk for mass storage and with CP/M. That system prices out at \$1530.

System expansion continues even in the CBM lineup with the *PET 4016N*. By adding one disk drive to the *4016N*—giving 170K of on-line storage, the price is raised to \$1690.

Adding 64K of memory to the *CBM 8032B* raises its price to \$1995, but that gives a total of 96K of RAM, which is more than



IN ITS NEARLY FULLY CONFIGURED FORM, the Netronics *Explorer 85* includes a floppy-disk drive and CP/M.

HARDWARE
\$1500-\$2000

adequate for just about any task that can be imagined.

And, speaking of Commodore, a new system makes its appearance in this category, too, the *SuperPET SP9000*, priced at \$1995. This is an enhanced 8032 with a second processor, an 8-bit 6809. The *SuperPET SP9000* is a very capable unit with 96K of RAM. The languages it recognizes include Waterloo's microBASIC, or microAPL, microPascal, and microFOR-TRAN; it can also be programmed in 6809 assembly language. That gives this machine a great deal of computing power.

System expansion continues even with the Atari 800 home computer. When this system is fleshed out with a cassette recorder, the modem-expansion unit, and a printer, the cost rises to \$1552.

Even the Radio Shack TRS-80 Color Computer has an entry in this price category for home use. With 16K, one disk drive, printer, and color receiver the price is almost \$1900. R-E



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MARC STERN

THE PRICE RANGE BETWEEN \$2000 AND \$2500 IS POPULATED BY relatively few personal computers. And, most of those in this spectrum are really upgrades of existing systems. As noted earlier, it seems as if there are few computers in the middle price ranges. Instead, home computers tend to populate the low and high ends of the pricing spectrum.

So, what will a potential buyer find in this price range? The buyer will find that the upgrades of the various systems will consist of increased RAM memory and increased mass storage via the addition of disk drives. Of course, there are some new systems that make their first appearance in this range.

Intertec

The first new system to appear in this range is Intertec Data System's *Superbrain Jr.* It is another of the all-in-one types of home computers, including not only the keyboard, but also the CRT and disk drives in one terminal-like housing.

This computer system is driven by dual Z80 CPU's with a fast clock rate of 4 MHz. This speed gives this system the ability to access, digest and, return data quickly. The operating system is the industry-standard CP/M 2.2 and the system language is BASIC.

In this dual-processor-type of system, one Z80 performs data processing while the other performs "housekeeping" chores such as display functions. Since the first Z80 is relieved of the housekeeping chores, the actual data processing is much faster.

The keyboard includes an 18-key keypad for numeric data entry. Since this is an all-in-one machine, it also includes a 12-inch CRT that is capable of the standard 80 x 24 display. This green phosphor CRT has a 20-MHz bandwidth. The *Superbrain Jr.* is capable of interfacing with peripheral equipment via a pair of serial ports.

MicroSource

Another personal computer that makes its appearance in this price category is the MicroSource *M6000P*, an entirely modular unit.

Driven by an eight-bit Z80, the *M6000P* is another of the truly portable all-in-one computers appearing on the market. Like both the *Osborne I* and the *Kaypro II*, this portable runs the CP/M operating system. This is one of the later versions of

CP/M, version 2.2.

When fully configured, this system consists of dual 5¼-inch drives, a built-in nine-inch CRT display, and a full 83-key keyboard that includes not only a 10-key numeric keypad for rapid data entry, but also features four user-definable keys and 12 special function keys.

Of course, the fully configured system is much more expensive than the model that fits into this area of the price spectrum. The model that is described here does not include the floppy disk drives and is priced at \$2195. What sets it apart from both the *Osborne I* and the *Kaypro II* is the fact that both lower-priced systems come equipped with powerful software packages, along with the operating system, while MicroSource lists only the operating system.

Apple

Some of the other systems in this section are upgrades of basic systems. For example, in this version, the *Apple II Plus* has had its capabilities extended in both RAM, mass storage, and its CRT. The \$2495 price tag adds 32K of RAM—needed so the DOS 3.2 will run. This extra RAM also supports a far more powerful range of applications. In this configuration, the user can run such higher-level languages as Pascal, FORTRAN and Pilot.

For mass storage, no longer does a user have to rely on a cassette tape recorder. Instead, he gains a single double-density 5¼-inch floppy disk for data storage, quite a step forward in system speed and data access. In this configuration, too, the user gains a 12-inch green CRT display.

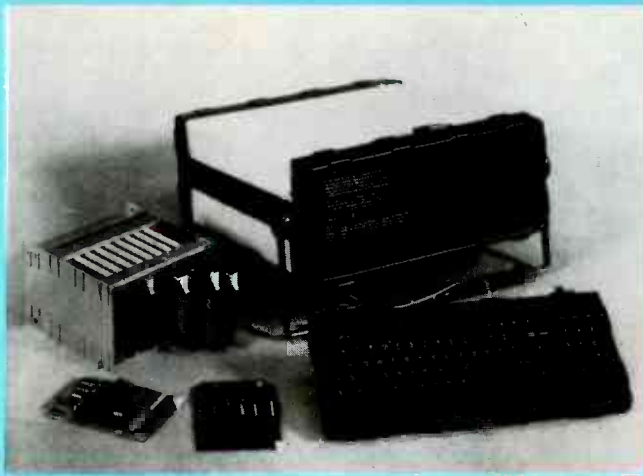
As you can see, this is a far cry from the basic keyboard computer and its cassette-type mass storage.

Radio Shack

The same is true of Radio Shack's *TRS-80 Model III*. In its \$2495 configuration, the user gains access to dual 5¼-inch floppy disk drives for much greater data storage. The double-density drives allow for storing as much as 360K of data, quite an improvement over a cassette-based system.

In this version, too, the user gains 32K of built-in RAM memory. Now 48K, this expansion allows the user to interface not only the disk operating system TRSDOS, but also the

OCTOBER 1982



THE MICRO SOURCE M6000P is a portable computer that can be configured for almost any application.

higher-power disk BASIC.

With this system, a user can handle such tasks as word processing and some business information handling. All that is missing from this picture to make this a fully configured system is a printer and perhaps a communication interface such as a modem. The capability for communications is built in through the RS-232C serial I/O port.

NEC

For \$2375, a PC-8001 buyer gains much more capability. The extra money brings 32K of RAM, enough to handle the CP/M operating system, and 286K of mass storage. It also brings a 12-inch green monitor with a standard 80 x 25-line display format.

With this type of system a user should be able to handle word

processing and information-handling chores. And, as you can see, the system has started to become much more powerful, as have the others so far described.

At this level, too, the PC-8001 buyer will gain access to such high-level languages as COBOL, FORTRAN, Pascal and BASIC. In this 32K configuration, this personal computer is able to handle far more complex tasks, much more quickly than the less expensive version.

Sony

Sony's SMC-70 is another example of a system that has gained a great deal of power with the addition of relatively little money.

What does the buyer gain for his \$2125? The answer to this one is more RAM and greater mass storage. However, it's mass



THE APPLE II PLUS from Apple is shown here with its accessory Monitor III and two disk drives.

TABLE 5—\$2000-\$2500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple II	\$2495	6502	8 bits	DOS 3.2	BASIC, Pilot Pascal, FORTRAN
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	CBM 8032B	\$2190	6502	8 bits	proprietary	BASIC
Hewlett-Packard 1000 N.E. Circle Dr. Corvallis, OR 97330	HP-85	\$2495	Z80	8 bits	proprietary	BASIC
Imsai Comp. Div., Fischer-Freitas Corp. 910 81st Ave. Oakland, CA 94621	Imsai PCS-42	\$2490	8085	8 bits	IMDOS, CP	CBASIC, other CP/M compatible
Intertec Data Systems 2300 Broad River Road Columbia, SC 29210	Superbrain Jr.	\$2494	Z80	8 bits	CP/M	BASIC, other CP/M compatible
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI-C4P-MF-24K	\$2050	Z80	8 bits	OS-65D	BASIC
Micro Source 595 N. Clayton Rd. New Lebanon, OH 45345	M6000P	\$2195	Z80	8 bits	proprietary	BASIC
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	NEC PC8001	\$2379	uPD 780 c-1 (Z80-like)	8 bits	proprietary	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$2495	Z80	8 bits	TRSDOS, NEWDOS, CP/M	BASIC, other CP/M- compatible
Radio Shack	TRS-80 Color Computer	\$2500	6809	8 bits		BASIC
Sony 7 Mercedes Dr. Montvale, NJ	SCM-70	\$2125	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Texas Instruments PO Box 22501	TI-99/4A	\$2324	TMS9900	16 bits	proprietary	BASIC, editor/assembler

storage with a twist, as we shall see.

In this configuration, the Sony *SMC-70* has 32K of built-in RAM. This should be more than enough to handle any system-related tasks and it gives the user access to the higher-level Pascal programming language. The user already has access to BASIC. In this configuration, too, the user gains 280K of mass storage on a single double-sided, double-density micro—yes, that's micro—floppy disk drive.

Rather than relying on the industry standard 5¼-inch disk, Sony has opted for its own 3½-inch micro disks. In truth, they have as much mass storage capability as larger disks, but a user is locked into the Sony system for his disks, which can be somewhat of a drawback. On the plus side, though, if this system becomes widely accepted in the personal computer market, then it is likely there will soon be micro disks from many aftermarket sources. In fact, with the amount of space they save, it is possible the rest of the industry could move in this direction. But, who knows what the future will bring?

M/A COM OSI

Even M/A COM OSI's system continues building in this building block manner. Its *C4P-MF-24K* system builds on the *C4P* computer and adds some very functional features. For starters, there's more built-in RAM, with 24K. This should give the user enough RAM to support the OS-65D operating system. This system includes color video output, AC control interfaces: D/A converter, and music output.

At this level, the buyer will also gain a 5¼-inch minifloppy disk, which provides greater mass storage. It will also speed system time because of quicker data access. This system also includes a security interface and a 16-line I/O port.

Imsai

Imsai also has an entry in this price category, and, to be honest, for the person looking for a good micro-mainframe

computer, any of the Imsai products is a good choice; in this price segment, there's Imsai's *PC-42*. It handles system expansion to the tune of 10 slots on the motherboard, and, in the correct configuration, it should be able to handle multiusers.

This computer is driven by an 8085 CPU with a clock speed of 3 MHz. It also features dual 5¼-inch minifloppies that have multi-format recognition capabilities. A Z80 board is also listed among the option for this microcomputer.

The beauty of this system is its ability to address different floppy disk densities. This should give the user the ability to install higher-density disks. It features both serial and parallel ports for interfacing.

Interestingly, this is a dual operating system machine. It will recognize the company's proprietary IMDOS operating system or the industry standard CP/M. The BASIC it uses is CBASIC, which is a compiler version and allows for flexibility in string or



Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
32K/5¼-inch floppy disk		standard		40 × 24	color video output, green CRT
32K/5¼-inch floppy disk		standard, numeric keypad	IEEE-488	80 × 25	12-inch integral display
64K/cartridge		94 keys, 14 programmable	IEEE-488	32 × 16 text, 192 × 256 graphics	integral 5-inch display & printer
32K/dual 5¼-inch floppy disks		N/A	serial parallel	N/A N/A	micro-mainframe
64K/5¼-inch double density floppy disk		80 keys, 18-key keypad	serial	80 × 25	12-inch green integral display
24K/5¼-inch floppy disk		standard	serial, 16-I/O lines		color-video output
64K		standard		80 × 24	
32K/dual 5¼-inch floppy disks		84 keys	serial parallel	80 × 25	12-inch green CRT
128K/dual 5¼-inch floppy disks		65 keys, 12-key keypad	parallel serial	64 (32) × 16	integral 12-inch display printer
32K/5¼-inch floppy disks		53 button-type keys	serial	8 colors, 192 × 256	
32K/3½-inch micro-floppy disks		72 keys, 5 programmable	serial parallel	80 × 24 text, up to 640 × 400 graphics	
40K/cassette		standard	serial	32 × 24 text, 192 × 256 graphics	printer, 10-inch color monitor



A POWERFUL COMPUTER IN ITS BASIC FORM, the power of an HP-85 from Hewlett-Packard can be increased with the addition of a printer and plotter.

file-handling. Since it is also a compiler language, it also tends to have a faster run time.

At \$2490, this system packs a lot of potential and it makes sense for the potential buyer looking for a micromainframe-type computer with its associated versatility in configuration and expansion. Since this system is contained in a system box, the user has the flexibility of obtaining his own peripherals.

Commodore Business Machines

With the addition of a single minifloppy disk drive to CBM's all-in-one 8032B, the price of this system rises to \$2190. This gives the user of this system access to more mass storage—170K. The minifloppy disk drive also increases the system speed because of faster data access.

Texas Instruments

Texas Instruments is another computer manufacturer whose upgraded personal computer falls into this category. At \$2324, a user can have a pretty complete system, with the exception of disk drives. Mass storage is still cassette-based, and the system still has only 16K of RAM, but a printer and 10-inch color monitor has been added.

Radio Shack

Even the Radio Shack TRS-80 Color Computer is upgraded to a complete, powerful system in this price category. For \$2500, its RAM memory is increased to 32K and this provides the user with access to the much more powerful Extended Color BASIC language, with its powerful data-handling capabilities.

This system also has more than 300K of mass storage on dual, single-sided, double-density 5 1/4-inch minifloppy disk drives. It also includes a dot matrix line printer. Thus, it is a full-featured system with considerable graphics power.

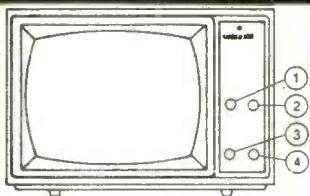
Hewlett-Packard

The \$2495 HP-85 is a powerful computer system right out of the box. A slim-line, all-in-one computer, it combines powerful graphics capability with expandability into a trim package.

Like many other personal computers on the market, the HP-85 uses a Z80 processor. It features a built-in CRT.

The 94-key keyboard of this portable personal computer contains a numeric keypad for rapid data entry and contains a built-in thermal printer for hard-copy output.

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A 16/8-bit system and a fully configured handheld computer are just some of the things that you'll find in this price range.

MARC STERN

IN THE PERSONAL COMPUTER MARKETPLACE, THERE'S AN INTERESTING phenomenon taking place. Slowly, but surely, 16-bit CPU's are beginning to make their presence felt in more and more systems. It's not that the eight-bit CPU is going to become obsolete overnight, it's just that 16-bit machines offer more powerful system architecture and faster system operating time.

Eight-bit machines will likely be around for many years to come because they offer a wide range of capability. However, the 16-bit machines offer far more flexibility and power and they are likely to become the dominant machines of the future.

We've already seen how there are now 16-bit CPU's already being used in the lower price-range personal computers. Both IBM and Olivetti use 16-bit CPU's and other systems make use of them as peripheral processors (*MTU-130*, but we'll get to that). And, in the \$2500 to \$3000 price range, the 16-bit computer from Commodore Business Machines makes its appearance.

Commodore Business Machines

The *BX256* from CBM is part of their enhanced "B" series personal computer line. In reality, this computer is aimed at the business segment of the microcomputer market.

Like another entry in the personal computer market from Digital Equipment Corp. (we'll get to it a little later in our survey), the *BX256* is a dual-processor personal computer. This might lead one to believe that it contains a pair of Z80A's or 8080's, but this isn't the case. Instead, it contains a 16-bit 8088 and an eight-bit 6509.

Although Commodore provides very little information about how the computer functions internally, we would assume that the dual-processors function something like this: When one processor is tied up, the other processor will handle system "house keeping" functions, keyboard I/O and display functions. Conversely, when the second CPU is processing, the first must act in a like manner.

Thus, the user gains the full speed and power of both CPU's independently. For instance, this system will recognize CP/M-86, the 16-bit version of the standard CP/M. It will also run the standard 8-bit version of CP/M. The software activates the correct CPU.

Thus, 16-bit software will run on the 16-bit processor, while the eight-bit processor handles the "house keeping" chores, and 8-bit software will run on the eight-bit CPU while the 16-bit CPU handles the chores.

Rather than having to work through a master eight-bit CPU, which addresses a peripheral 16-bit processor, the programming accesses either one directly and the user gains all the power and speed built into the system. It's a good feature for the buyer interested in upgrading to 16-bit power while retaining the investment in eight-bit software.

The *BX256* is a potent system in its own right. It comes with 256K of standard RAM, which is quite a bit of memory in a \$2995 machine. This means this system has more than enough internal memory to handle whatever tasks a user or system may ask of it. It will easily work with either the standard version of CP/M or CP/M-86.

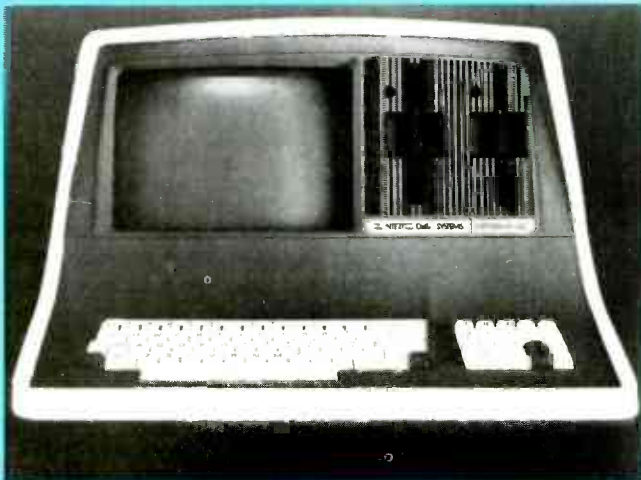
Like other all-in-one CBM personal computers, this one comes with a standard 12-inch green phosphor CRT with an 80-column x 25-line display. It also features dual built-in quad density (double-sided, double-density) 5¼-inch minifloppy disk drives.)

The 94-key keyboard can be detached from the system unit and can be lap-held, a convenience that allows the user to find the most comfortable work position. This keyboard includes a separate keypad for numeric data entry and it has 10 user-programmable keys, another good feature. Interestingly, this keyboard also has a double-zero key and while CBM doesn't explain its function clearly, it is likely this key has to do with the display's memory and graphics capability.

TABLE 6—\$2500-\$3000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Atari Home Computers 1265 Borregas Ave. Sunnyvale, CA 94086	Atari 800	\$2685	6502B	8 bits	proprietary	BASIC
Billings Computer Corp. 18600 East 37th Independence, MO 64057	Billings 100	\$2995	Z80	8 bits	proprietary	BASIC
Commodore Business Machines 487 Devon Park Dr. Wayne, PA 19087	CBM 4032	\$2590	6502	8 bits	proprietary	BASIC
Commodore Business Machines	BX256	\$2995	8088/6509	8/16 bits	proprietary, CP/M	BASIC, Pascal, other CP/M compatible
Commodore Business Machines	CBM 8032B	\$2690	6502	8 bits	proprietary	BASIC
Heath Co. Benton Harbor, MI 49022	H11A	\$2595	KD-11HA	16	HT-DOS	FORTRAN, BASIC
Heath Co.	H-89	\$2520 (kit)	Z80	8 bits	HDOS, CP/M (optional)	BASIC, FORTRAN, UCSD p-Pascal, other CP/M compatible
Heath Co.	H-89	\$2790 (kit)	Z80	8 bits	HDOS, CP/M (optional)	BASIC, FORTRAN, UCSD p-Pascal, other CP/M compatible
Hewlett Packard 1820 Embarcadero Rd. Palo Alto, CA 94303	HP-87	\$2750	Z80	8 bits	proprietary, CP/M	
IBM Information Systems Baco Raton, FL 33432	PC	\$2665	8088	16 bits	PCDOS, (optional)	BASIC, UCSD Pascal IV, COBOL
Imsai Corp., Div., Fischer-Freitas Corp. Oakland, CA 94521	PCS-42	\$2640	8085	8 bits	IMDOS, CP/M	CBASIC, other CP/M compatible
Intertec Data Systems 2300 Broad River Rd. Columbia, SC 29210	Superbrain QD	\$2995	Z80	8 bits	CP/M	BASIC, other CP/M compatible
Micro Technology Box 12106 Raleigh, NC 27605	MTU 130-10	\$2999	6502	8 bits	CODOS	BASIC, UCSD Pascal
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	PC8001	\$2849	uPD780 c-1 (Z80-like)	8 bits	proprietary	BASIC
Olivetti 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$2965	Z8001	16 bits	PCOS	BASIC
Panasonic 1 Panasonic Way Secaucus, NJ 07094	RL-1000	\$2879		8 bits	N/A	BASIC
Panasonic	RL-1400	\$2979		8 bits	N/A	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$2557	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN
Radio Shack	TRS-80 Model III	\$2932	Z80	8 bits	TRSDOS	BASIC, COBOL, FORTRAN
Sony 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$2950	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Sony	SMC-70	\$2500	Z80A	8 bits	CP/M	BASIC, Pascal, other CP/M compatible
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$2824	TMS9900	16 bits	proprietary	BASIC, editor/assembler
Zenith Data Systems 1000 Milwaukee Ave. Glenview, IL 60025	Z-89	\$2895	Z80	8 bits	HDOS, CP/M (optional)	BASIC, FORTRAN, UCSD p-Pascal, other CP/M compatible
Zenith	Z-90	\$2895	Z80	8 bits	HDOS, CP/M	BASIC, FORTRAN, UCSD p-Pascal, other CP/M compatible

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
16K/dual 5¼-inch floppy disks		61 keys, 4 special function	serial, parallel	40 × 24 text 320 × 192 graphics	printer, color output to TV set
64K/dual 5¼-inch floppy disks		94 keys, 16 special-function	80 × 24		
32K/dual 5¼-inch floppy disks		standard	IEEE-488	40 × 24	
128K/dual 5¼-inch floppy disks		94 keys, 10 programmable	IEEE-488, serial	80 × 25	
96K/5¼-inch floppy disks		standard, numeric keypad	IEEE-488	80 × 24	
64K/dual 8-inch floppy disks			serial		
48K/dual 5¼-inch floppy disks		84 keys, 12 special-function	serial	80 × 24 text, 33 graphics characters	integral monitor
64K/dual 5¼-inch floppy disks		84 keys, 12 special-function	serial	80 × 24 text, 33 graphics characters	integral monitor
64K/dual 5¼-inch floppy disks		standard	serial,	80 × 24 text 544 × 240 graphics	
64K/5¼-inch floppy disk		83 keys, 10-key keypad, 10 special-function keys	serial, parallel	80 × 24	11½-inch green CRT
64K/dual 5¼-inch floppy disks		N/A	serial, parallel	N/A	micro-mainframe
64K/dual 5¼-inch floppy disks		80 keys, 18-key keypad	serial	80 × 25	12-inch B&W monitor
80K/8-inch floppy disk		96 keys, 8 programmable	serial, parallel	80 × 24 text, 480 × 256 graphics	Light pen
64K/dual 5¼-inch floppy disks		84 keys	serial, parallel	80 × 25 text	12-inch B&W monitor
128K/5¼-inch floppy disk		72 keys	serial, parallel	80 × 25 text, 512 × 256 graphics	12-inch B&W monitor
36K/cassette		65 keys	serial	video package	modem, I/O adaptor, system case
36K/cassette		65 keys	serial	video package	modem, I/O adaptor, system case
16K/cassette		65 keys, 12-key keypad	serial, parallel	64 (32) × 16 text, 64 graphics characters	printer, graphics plotter
48K/5-inch floppy disk		65 keys, 12-key keypad	serial, parallel	64 (32) × 16 text, 64 graphics characters	printer
64K/dual 3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	80 × 24 text, 640 × 230 graphics	
64K/3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	80 × 24 text, 640 × 230 graphics	
48K/5¼-inch floppy disk		standard	serial	32 × 24 text, 192 × 256 graphics	high level graphics option
48K/5¼-inch floppy disks		84 keys, 12 special-function	serial	84 × 24 text, 33 graphics characters	integral monitor
64K/5¼-inch floppy disks		84 keys, 12 special-function	serial	80 × 24 text, 33 graphics characters	integral monitor



ADDING A DISK DRIVE to the Intertec *Superbrain QD* greatly increases its storage capability.

While this machine is aimed at the serious business user, it still retains sound synthesis capabilities. It is capable of three-part harmony over nine octaves, something you won't find in many business computers.

On the whole, this is a powerful machine in its own right, but its capabilities can be further expanded with the addition of a hard disk and printer. However, this raises the system's price considerably.

There are other CBM entries in this price class, too. For instance, by adding dual floppy-disk drives to the *PET 4032N* and increasing the mass storage capacity to a total of 340K on single-sided double-density disks, the cost of this system rises to \$2590. And, by adding 64K of RAM memory to the *CBM 8032B*, along with a single disk drive with its 170K of mass storage, then the price will rise to \$2,690.

Panasonic

Believe it or not, even a fully-configured handheld system's price can reach this region. Look at the *Panasonic H1000* and *H1400*. When this system is fully configured with a video interface, 36K of RAM (which must be daisy-chained), an I/O adapter for peripherals and an attache case into which this system fits, the price rises to \$2979 for the *H1400* and \$2879 for the *H1000*.

Fully equipped the whole system is known as *The Link* and it makes a handheld microcomputer into a full-featured portable terminal. The features and peripherals added should make this system very attractive for the business traveler, especially one who must communicate with a mainframe or electronic mail system.

NEC

In this price range, we also find many systems beginning to take on a great deal of computing power. For example, the \$2849 *NEC PC-8001* now has 64K of RAM and it gains its true potential as a system. In this configuration, this system can run CP/M, as well as the high-level Pascal language. The other languages that can also run on this machine include FORTRAN, as well as COBOL, NBASIC (also the system language) and CBASIC, the faster compiled BASIC.

In this configuration, the system has also gained dual 5¼-inch minifloppy disk drives that provide up to 280K of mass storage. Its potential for further expansion is increased with the addition of an expansion interface box that offers card slots and the potential to increase the system's RAM to 128K. This is a modular system and in this configuration, NEC's 12-inch green phosphor monitor has been added. It features the industry-standard 80 × 25 display. In reality, in most systems the 25th line of the display is reserved for status use, so it is really a 24-line display for text. Please refer to the previous discussion of the basic system.

Intertec

Another system upgraded is available from Intertec Data Systems. It is the \$2995 *Superbrain QD* and it is a step up from the *Superbrain Jr.* The essential difference in this all-in-one computer is the amount of mass storage. Where the *Superbrain Jr.* offers mass storage of 350K on one quad-density minifloppy disk drive, the *Superbrain QD* offers 750K. This additional mass storage greatly increases the capability of this dual-processor system.

Unlike a 16-bit/8-bit dual processor unit, this one uses dual eight-bit Z80's with a high clock speed of 4 MHz. This allows for much more rapid data access and use. Since it is a dual-processor system, the speed is enhanced because one processor handles the data processing, while the other handles the "house-keeping."

The standard operating system of this and other Intertec offerings is CP/M 2.2. It also comes equipped with 12-inch green CRT and keyboard.

Heath/Zenith

Another dual eight-bit microprocessor system is the *H89* from Heath. This is one of the few computers that are available in kit form. This is also sold fully-assembled as the *Z89* by Zenith. Please refer to the previous discussion for a full description of this system.

The *H89*, in this configuration, has been upgraded by the addition of dual 5¼-inch floppy disk drives with a mass storage capacity of 200K. This \$2525 all-in-one computer in kit form comes with a standard 84-key keyboard and 12-inch black and white CRT. The computer is driven by a pair of Z80's with a clock speed of 2.048 MHz. Its 48K of RAM is enough to work with its HDOS operating system and CP/M. A user is also capable of using BASIC, FORTRAN and UCSD-p-Pascal programming languages.

This isn't the only Heath/Zenith entry in this price category. An upgrade *H89* kit is available. In this \$2790 configuration the standard amount of RAM is increased to 64K.



The *H89* FROM HEATH is one of the few computers available in kit form. It is also available fully assembled as the *Z89* from Zenith.

IBM

IBM's *Personal Computer* also gains a great deal of power in this price range. The basic system was described previously, so here we will concentrate on what has been added.

Specifically, this system gains about 320K of mass storage through the addition of one double-sided, double-density disk drive. Its RAM has also been increased from 16K to 64K, which allows this system to work with the high level BASIC compiler, UCSD-p-Pascal and COBOL. Its price is now \$2665.

The other addition to this system has been the 11½-inch green CRT that has the standard 80 × 25 display.

Sony

Sony's *SMC-70* upgrades twice in this price range. In its first upgrade, which increases the price to \$2500, the amount of RAM has grown to 64K, while one 3½-inch microfloppy disk drive has been added. This gives this system 280K of mass storage. Another enhancement to this system is the addition of a 12-inch green CRT. Please refer to the previous discussion for a full description of the basic system.

The second *SMC-70* upgrade consists of adding a second microfloppy drive for a total of 560K of mass storage. This gives this system far more power and makes it a better buy for the \$2950 price tag.

Olivetti

Still a further system upgrade in this price category comes from Olivetti, whose \$2965 *M-20* gains 320K of mass storage with the addition of one double-sided double-density disk drive. Also added to this system is the standard black-and-white CRT.

This system, thanks to its 16-bit processor, has quite a bit going for it and, as you can see, its potential power is now capable of being used.

Micro Technology

The same can be said for Micro Technology's *MTU-130*. In its \$2999 configuration, this system gains 1 megabyte of mass storage through the addition of one quad-density eight-inch floppy disk drive. When this is combined with the system's standard 80K of RAM, one can see the power built into this system.

Atari

Even some of the lower-priced home computers have system upgrades that bring their price into this category. For instance, when you add two disk drives for mass storage to the *Atari 800* system, plus a dot matrix printer, the system's price easily rises to \$2685. It is also quite a powerful system in this advanced version.

The *Atari 400* system can also be configured into a level that brings its prices into this spectrum. When this system is equipped with dual, 5¼-inch minifloppy disks, modem and communications software, and a printer, the system cost rises to \$2572.

Radio Shack

Radio Shack also has an entry in this category. It is an expansion of its 16K *TRS-80 Model III*, but it still relies upon a cassette recorder for mass storage. The additions to this system—aimed at engineers—consist of a graphics plotter and a printer and its price increases to \$2557.

Another expansion of the *TRS-80 Model III* results in what Radio Shack calls their "Complete World Processing System." This time, the RAM memory is increased to 48K and the expansion includes a dot-matrix line printer, a disk drive and word processing program. At \$2932 it is quite a package.

Texas Instruments

The same is true of the Texas Instruments *TI-99/4A*. When you expand its RAM to 32K and add a drive, video controller and a 10-inch monitor (a pretty complete system for both home and business use), then you find the price rising to \$2824.

Billings

Here's a newcomer to this price range. Although the Billings Computer Co. has been selling computers to businesses for the last five years, this is their first entry into the lower-priced microcomputer market.

Although this company makes several microcomputer-based systems, their *100 Series*, priced at \$2995, is their entry-level machine.

Based on an eight-bit Z80 CPU, this system features a high-contrast green CRT screen and a detachable keyboard with 16



function keys, a numeric keypad and eight cursor control keys. It also sports a standard typewriter keyboard for a total of 94 keys.

Mass storage is via dual, single-sided, single-density 5¼-inch minifloppy disk drives which provides about 100K of storage for a user.

Imsai

Micromainframe-type systems still abound in the microcomputer world and in this price range we find two, one from Imsai, the second from Heath.

Imsai's *PCS-42* micromainframe-type of computer benefits from the addition of 32K of RAM in this \$2640 configuration. This gives this system the potential of taking full advantage of either the IMDOS operating system or CP/M 2.2. Mass storage is provided by dual 5¼-inch single density disks. With these drives, 100K of mass storage is provided.

Heath

A very powerful system is the Heath *H-11A* kit. It is powered by a custom-made KD-11HA CPU. Equivalent to a 16-bit system, it is capable of acting as a mainframe for several terminals.

The CPU itself recognizes the DEC *PDP 11/34* instruction set and HT-DOS. Thus you can see the potential power built into the machine. It is capable of running FORTRAN. At \$2595, the buyer is gaining a great deal of potential computer power for the money.

In its standard configuration, this microcomputer is capable of addressing 64K of memory, which includes 56K of RAM and 8K of system ROM. It is capable of further expansion thanks to the eight expansion slots on the S-100 motherboard. It packs a great wallop for the money.

Hewlett-Packard

The \$2750 Hewlett-Packard *HP-87* is an all-in-one computer. This is a dual-processor system that is driven by an eight-bit Z80 CPU and an eight-bit 80-series CPU. The user is able to take advantage of the wide variety of software available that runs under these processors. He is also able to take full advantage of the power built-into the Z80 because of the dual nature of this unit.

The basic system consists of a 94-key keyboard that is contained in a slim-line terminal-type housing with 64K of RAM that is available to the Z80 and 48K that is available to the 80-series CPU. This system, via its high-resolution built-in CRT, also has high-level graphics capability.

The system language is BASIC and it will run under either CP/M or H-P's own disk operating system.

Another \$2750 system is Hewlett-Packard's *HP-125*. Also driven by an eight-bit Z80, this system has 64K of RAM standard. This is more than enough RAM memory and when interfaced with dual minifloppy disks, this system provides 500K of mass storage.

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HARDWARE

\$3000-\$3500

There's quite a bit to choose from in this price range. Among what you'll find are both basic systems and upgraded versions of less expensive machines.

MARC STERN

WHEN YOU LOOK AT WHAT'S AVAILABLE FOR BETWEEN \$3000 and \$3500, one thing immediately hits you—the number of systems on the market. Those are split just about 50-50 between upgrades of lower priced systems and sophisticated machines that were intended to sell for that price in their basic form. Among the ones in the later category are computers from giants Xerox and Digital Equipment Corporation (DEC).

Another thing that is apparent is that 16-bit machines are still not that common. True, there are a few, such as the one put out by DEC, but most are still 8-bit machines.

Xerox

Let's begin by looking at the Xerox 820II. The microprocessor used here is a Z80A. The microprocessor and the 12-inch, black-and-white monitor are housed in a single case; that monitor can display up to 24 lines of 80 characters each. The system also comes with a 96-key keyboard that includes a 10-key keypad for rapid numeric data entry. (That type of keypad, included on so many keyboards, is a blessing, especially when a user is working with long arrays of numbers. The absence or presence of such a keypad is something that should be considered when comparing personal computers.)

As you would expect with a computer at this price level and sophistication, it comes with 64K of RAM standard and two 5¼-inch disk drives; those drives are capable of handling either single- or double-sided, double-density disks. The operating system is an enhanced version of CP/M. Eight-inch drives could also be used with the machine if desired. Two RS-232C serial ports and two parallel ports are provided for expansion.

Among the nice features of this machine is its user friendliness. For example, a menu-driven system is provided to help users over the rough spots. If you've ever used something like that, you know how much help it can be.

This computer, which sells for \$3295, is an enhanced version of their 820. Among the improvements offered by the newer

system is a faster microprocessor, an enhanced CP/M, and better use of memory space. The older version, which sells for \$2995, will still be available for a short time. Incidentally, Xerox will upgrade the older 820 to the 820II for \$400.

DEC

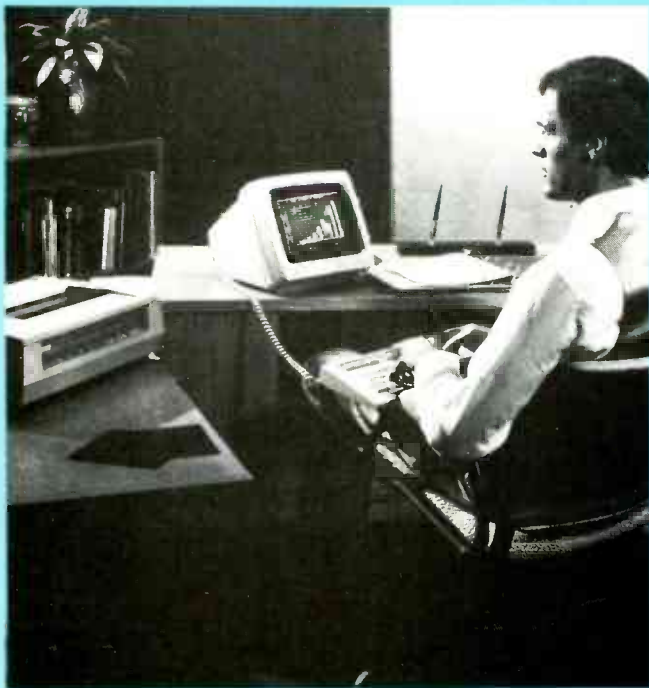
Digital Equipment Company (DEC), a giant in the mini- and small-mainframe-computer field, has entered the microcomputer market with the introduction of three new personal-computer systems. One of those that falls within this price category is the *Rainbow 100*; it sells for \$3495, complete with its special operating system (more on that later).

That all-in-one system consists of a 103-key keyboard, 12-inch monochrome CRT monitor, and dual, double-density, 5¼-inch disk drives; those drives have a total storage capacity of 800K. It also includes 64K of RAM. The lightweight 103-key keyboard is a separate unit and can be positioned for maximum user comfort. Some users have commented that they don't like the feel of the keyboard, but that may be because it is fairly sensitive and requires just a light touch.

What sets that unit apart, however, is that this is a 16/8-bit dual microprocessor machine. It works much like other dual processor machines on the market—but with one major difference. As the machine uses both a Z80 (8-bit) and an 8088 (16-bit), it will run programs written for either of those microprocessors.

The idea of using dual microprocessors is not new. Formerly, however, two 8-bit microprocessors would be used—one would do the actual processing while the other handled the keyboard, display, etc. That effectively speeded up system access and function time because it eliminated the need for having a single CPU handle all the tasks.

The same thing happens here too—one microprocessor handles the processing while the other take care of the housekeeping. The special CP/M-86/80 operating system determines whether a



DEC'S RAINBOW 100 personal computer is compact and can run either 8-bit or 16-bit software.

program is in 8- or 16-bit-wordlength form and invokes the appropriate microprocessor to run the program, with the other acting as a controller and handling the housekeeping. Thus, a user has access to the full capabilities of either a Z80 or 8088 microprocessor. One big advantage to this scheme is that the user gains access to the latest 16-bit software without making obsolete his existing 8-bit CP/M software; that existing software often represents a considerable investment and would be very costly to replace. The *Rainbow 100* can also run under Microsoft's MS/DOS, a 16-bit operating system.

Apple

Apple, one of the best known names in personal computers, also has a system in this price category. That system, the *Apple III* was developed to meet the needs of business as well as for the advanced computer user. It sells for \$3495

Like the *Apple II Plus*, the *Apple III* is driven by an 8-bit 6502 microprocessor. The chief advantage of this system is its large amount of built-in RAM. At 128K, it is among the leaders in memory capacity. If you wish, that RAM can be expanded to 256K.

The system comes with one built-in single-sided, double-density disk drive. If desired, up to three additional drives could be daisy-chained for a total of 560K of storage. For massive storage requirements, a 5 megabyte hard disk is available.

Unlike the *Apple II's* 53-key keyboard, the integral 74-key keyboard here includes a numeric keypad. Such a keypad greatly speeds and simplifies the entry of long numbers.

TABLE 7—\$3000-\$3500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95105	Apple III	\$3495	6502	8 bits	SOS 1.1	BASIC, Pascal
Apple Computer	Apple II	\$3020	6502	8 bits	DOS 3.2	BASIC, Pilot, Pascal, FORTRAN
Digital Equipment Corp Maynard, MA 01754	DEC 100	\$3495	8088	8/16 bits	CP/M-86, MS-DOS	MBASIC, C
Heath Co. Benton Harbo, MI 49022	Z-90	\$3345	Z80	8 bits	MDOS, CP/M	BASIC, FORTRAN, COBOL, UCSD p-Pascal
Heath Co.	Z-90-82	\$3191	Z80	8 bits	HDOS, CP/M	BASIC, FORTRAN, COBOL, UCSD p-Pascal
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI 220C	\$3150	6502	8 bits	OS-65D	FORTRAN, BASIC, Pascal
M/A COM OSI	OSI C100	\$3285	6502	8 bits	OS-65D	FORTRAN, BASIC, Pascal
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$3472	Z80	8 bits	TRSDOS, CP/M (optional)	COBOL, BASIC, FORTRAN, editor/assembler
Sony Corp. 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$3470	Z80A	8 bits	CP/M	BASIC, Pascal
Sony Corp.	SMC-70	\$3020	Z80A	8 bits	CP/M	BASIC, Pascal
TeleVideo Systems 1170 Morse Ave. Sunnyvale, CA 94086	TeleVideo TS801	\$3295	Z80A	8 bits	MmmmOST, CP/M	BASIC, FORTRAN, COBOL, Pascal, APL, Algol, PL/1, Forth
TeleVideo Systems	TeleVideo TS802	\$3495	Z80A	8 bits	MmmmOST, CP/M	BASIC, FORTRAN, COBOL, Pascal, APL, Algol, PL/1, Forth
Xerox-Office Products Div. 1341 W. Mockingbird Lane, Dallas, TX 75247	820II	\$3295	Z80	8 bits	CP/M	MBASIC, CBASIC, COBOL

The high-resolution 12-inch green phosphor CRT is capable of displaying up to 24 lines of 80 characters each. In the graphics mode, the resolution is 280 × 192 pixels, which is good. The system can also drive almost any black-and-white or color monitor; 16-color graphics capability is standard.

One of the beauties of this system is its expandability—eight expansion slots are provided. Even when the RAM is expanded to its full 256K, four slots remain for expansion. Apple manufactures a full line of peripherals including printers, color plotters, and modems.

For present owners of *Apple II* systems, the *Apple III* has an emulation mode that will permit you to run your *Apple II* software. That is a big plus for those who already own a large inventory of Apple software—that software can be run on the new machine.

Teletideo

Teletideo has two systems in this price category, the *TS801* and the *TS802*. Those are essentially the same system—the only difference between them is that the *TS801*, which sells for \$3295, has a separate keyboard, monitor, and system box, while the *TS802*, which sells for \$3495, features an integrated unit with a detachable keyboard. Since those two systems are so much alike, let's treat them as one in our description.

The heart of the system is a Z80 microprocessor. The unit comes with 64K of RAM standard. For mass storage, two double-sided, double-density, 5¼-inch disk drives are provided. With those drives, a total of 1 megabyte of storage is

available. That gives the buyer quite a bit for his money.

The CRT is a green-phosphor-type and is capable of displaying 25 lines of 80 characters each. The keyboard is a 97-key typewriter-style unit. As it is housed in a separate case in the *TS801* and detachable in the *TS802*, the keyboard can be easily positioned for comfortable operation.

One interesting feature of this system is the addition of a 4K EPROM. A user can format and program a specific routine or routines into the EPROM; those can be changed whenever the user wants because the EPROM is, of course, erasable.



Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
128K/5¼-inch floppy disk		74 keys, 13 key keypad	serial	80 × 24 text, up to 180 × 192 graphics	12-inch green monitor
48K/dual 5¼-inch floppy disks		53 keys	serial, parallel	40 × text, 280 × 192 graphics	12-inch green monitor
64K/dual 5¼-inch floppy disks		103 keys	serial	80 × 24	12-inch B&W monitor
64K/5¼-inch floppy disk		84 keys, 12 key keypad	3 serial,	80 × 24	12-inch B&W CRT, multi-mode interface card
64K/5¼-inch floppy disk		84 keys, 12 key keypad	3 serial,	80 × 24	12-inch B&W
48K/dual 5¼-inch floppy disks			serial		
48K/dual 5¼-inch floppy disks			serial		
48K/5¼-inch floppy disk		65 keys, 12 key keypad	serial, parallel	64 (32) × 16	integral display, printer
64K		72 keys, 5 programmable	serial, parallel	up to 840 × 230	12-inch color monitor
64K 3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	up to 840 × 230	12-inch color monitor
64K/dual a5¼-inch floppy disks		97 keys	2 serial, 1 parallel	80 × 24	green CRT
64K/dual 5¼-inch floppy disks		97 keys	2 serial	80 × 24	green CRT, satellite port
64K/dual 5¼-inch floppy disks		96 keys, 14-key keypad	2 serial, 2 parallel	80 × 24	12-inch B&W monitor



THE APPLE III with Silentype printer.

On the software end, two operating systems are available. Those are CP/M and MmmOST Service Operating System, a Televideo proprietary operating system. Also, nine high-level programming languages are available—BASIC, FORTRAN, COBOL, Pascal, APL, Algol, PL/1, Forth, and C.

Other systems

The other systems available in this price range are upgrades of lower-priced systems; in general, those upgrades increase the power and/or flexibility of the basic system. For instance, the *Apple II Plus* reaches this price level if it is equipped with a second double-density 5¼-inch disk drive. Doing so increases the formatted mass storage capacity to 280K, and the price to \$3020.

Adding a high-resolution (650 × 230 or 250 × 300 pixels) color display increases the price of the Sony *SMC-70* to \$3020. Doing so allows you to make maximum use of the system's eight-color capability. For a total system price of \$3470 you can also add a second 3½-inch disk drive. That drive increases the storage capacity by 280K for a total system capacity of 560K.

Radio Shack's *TRS-80 Model III* system can also be upgraded into this price range. For \$3472, you can purchase what Radio Shack calls its Manager's System. That includes 48K of RAM, one double-density 5¼-inch disk drive, a line printer, and appropriate software including the *VisiCalc* spreadsheet program and *SCRIPSIT* word processing. Also included is a computer work desk.

At \$3195, an upgraded version of the Zenith *Z89* (also available in kit form from Heath as the *H89*) is available. That version includes one soft-sectored 5¼-inch disk drive for a storage capacity of 160K, and 64K of RAM.

M/A-Com-OSI also has two offerings in this category. For \$3150, you can purchase the *C2OEM*. That system consists of the 6502-based computer, 48K of RAM, OSI's OS-65U operating system, and two single-sided, double-density disk drives each allowing 275K of storage.

The *C4P-MF-48K*, with a price of \$3000, offers 48K of RAM and two eight-inch disk drives. Those drives should give the user about 550K of total system storage capacity. That 6502-based system features color-video output and comes with modem, cassette, printer, and AC-control interfaces. R-E

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74LS14N	99 2112-2	2.99	Z80S-510	19.50	AVS1013	3.95	EN6303-510
74LS20N	25 2114	2.24	Z80S-510	19.50	AVS1014	3.95	EN6304-510
74LS22N	25 2114L-300ns	2.50	8212	1.85	AVS1014A	16172.95	EN6307-510
74LS29N	35 2114L-500ns	2.37	8214	3.75	AVS1014A	16172.95	EN6308-510
74LS30N	25 2116-200ns	2.25	8216	8.00	3341	6.35	EN6309-510
74LS33N	55 8+16-200ns	13.75	8224	2.50	8086	65	EN6300-607
74LS38N	35 74MS200	3.00	8228	4.95	8088	65	EN6303-510
74LS47N	45 74MS121	9.95	8251	4.75	8096	65	EN6304-510
74LS50N	50 74MS130	5.94	8253	4.95	8098	65	EN6305-510
74LS50N	60 95101	8.95	8255	4.75	8098	65	EN6306-510
74LS593N	65 4200A	11.50	8257	8.75	8109	1.25	EN6307-510
74LS595N	65 5385	3.50	8259	6.90	8110	1.75	EN6308-510
74LS597N	60 490D	10.00	1802CE bias	13.95	8113	1.40	EN6309-510
74LS512N	45 416	2.50	1802E bias	13.95	8120	4.95	EN6310-510
74LS513N	45 74MS2016	9.95	1802P	5.95	8123	1.75	EN6311-510
74LS5132N	75 74MS116	10.95	MSV6532	8.95	8124	1.75	EN6312-510
74LS5136N	49 74MS116 L P3	11.95	2808	16.95	8125	3.70	EN6313-510
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74LS520N	100 6502BU	6.95	280 CTC	6.95	8128	5.99	EN6393-510
74LS520N	100 6502BV	6.95	280 CTC	6.95	8128	5.99	EN6394-510
74LS520N	100 6502BW	6.95	280 CTC	6.95	8128	5.99	EN6395-510
74LS520N	100 6502BX	6.95	280 CTC	6.95	8128	5.99	EN6396-510
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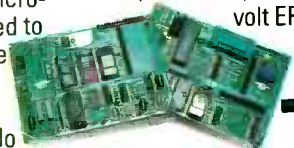
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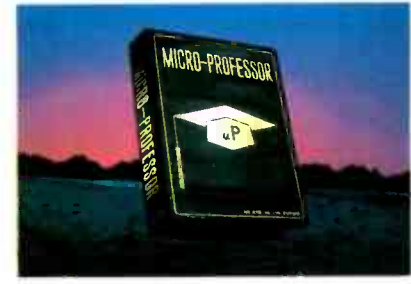


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\$3500 to \$4000



HARDWARE

\$3500-\$4000

Systems in this price range consist mainly of upgraded versions of more basic systems. But for the added cost, you get versatility.

MARC STERN

IF THERE'S ONE THING CERTAIN ABOUT THE COMPUTER MARKET, it's that: the higher in price you go, the more systems seem to be available. It's especially noticeable if you take a close look at the personal computer marketplace. And, no matter how high you go into the price spectrum, two other certainties also stand out: The eight-bit processor is still the champ, without a doubt, and CP/M is still the leading operating system.

Yes, it is true there are some systems taking advantage of the new generation of 16-bit CPU's, but there aren't that many. In this price category, there are only two systems that take advantage of it, while a third takes advantage of a proprietary 12-bit CPU.

But, speaking of specific systems themselves, it is in this price segment of the marketplace that many computer systems really begin to mature into truly powerful machines. It is also in this part of the spectrum that several new machines make their appearance and we will look at them first.

Three new names join the list at this juncture: those are Vector, North Star Computers, and Hitachi.

Vector

The \$3995 Vector 1600 is a very powerful system. Its high-speed Z80B crunches data at the super-high clock speed of 6 MHz. This system also features bank-switched RAM in 64K chunks. What this means is that while the operating system is resident in one 64K chunk of memory, the user can have another bank of 64K available for processing. This effectively reduces disk access time and it will allow for some spooling functions—using part of the memory for printing while the rest of the system is doing other tasks.

Clearly designed for business applications, the Vector 1600 is CP/M-dedicated. Its operating system is CP/M 2.5, one of the latest releases. Thus, this system will support BASIC 80, BASIC Compiler, FORTRAN, COBOL and Pascal. It also supports a RAID debugging program and ZSM Assembler, as well as a powerful business-accounting/word processing package.

The bank-switched memory also allows additional operating commands and new utilities to be added. User access to these functions is via a 72-key keyboard of which 10 keys are used as a numeric keypad for rapid numeric data entry.

This S-100 bus system has six card slots open on its motherboard and it will support a parallel printer without an optional interface. In fact, the three parallel ports are fully configurable by the user.

Mass storage is available in two standard quad density (double-sided, double-density) 5¼-inch minifloppy disks. This gives the user a total of 630K of potential storage. It also means there's more than enough storage for any task a user would like the system to tackle.

The CRT is a 12-inch bit-mapped unit, capable of the industry standard 80-character by 24-line display. The bit-mapping is also attractive because it will allow the user to directly address screen memory and move the cursor any screen location.

North Star

From North Star Computers of San Leandro, CA, comes the dual-processor *Advantage*. This system is another of a number on the market that takes advantage of a secondary processor which handles such routine "housekeeping" chores as servicing the keyboard and floppy disk drive control functions. This allows the Z80A to perform its processing function unhindered. It also means the user gets the advantage of the CPU's 4 MHz clock speed for quick data access and retrieval.

The operating system of this computer is North Star's CP/M-compatible Graphics BASIC/Graphics DOS (GDOS) for high-level graphics functions.

One of the prime aims of this system seems to be at those industries or users needing powerful graphics capabilities. The operating system allows the user to take advantage of the high-level bit-mapped graphics capability of the *Advantage*. Resolution of this system is 640 × 240 pixels, which will allow high-level graphics resolution. In the graphics mode, the *Advantage* will support both geometric and graphics functions. The four functions POLYGON, RECTANGLE, ELLIPSE, and SPECIAL LINE enable the drawing of points, lines and many two-dimensional figures. Other commands such as CLEAR, BLOCK, and CHAR are used to control the display operation.

The *Advantage* is another of the all-in-one computers on the market. It includes a standard green phosphor CRT that is

capable not only of high graphics resolution, but also the industry standard 80 × 24 display

This system has an 87-key keyboard that includes 15 function keys and 14 numeric/cursor controls on a separate keypad. It will also support system expansion through six bus slots for such expansions as serial or parallel I/O interfaces or North Star's Floating Point Board.

Dual quad-density 5¼-inch minifloppy disks provide a user with up to 360K of mass storage per drive or with up to 128 files per drive.

Not only will the GDOS operating system support high-level graphics functions, it will also support the use of such high-level languages as CBASIC, MBASIC, FORTRAN, or COBOL. The operating system is a superset of the industry-standard CP/M. Not only does the *Advantage* include a standard 64K of RAM, but it also has a separate 20K of display RAM, so the user can take advantage of the full-power of the bit-mapped screen.

Altogether, the \$3999 North Star *Advantage* is quite a powerful personal computer system that should be useful in the office, a laboratory, or at home.

Hitachi

Another new name also appearing in this segment is Hitachi, which has long been known in the consumer electronics field. Hitachi's entry is the \$3500, 16-bit *MB16001* personal computer. The new Hitachi system is still another entrant in the



DEC's *DECmate II* computer is primarily targeted for office management applications.

burgeoning 16-bit processor segment of the personal computer market.

Like other 16-bit systems on the market, a user is able to address a standard 128K of RAM—expandable to about 348K because of the amount of address space available in the 8088 microprocessor. This processor provides enhanced, high-resolution multi-colored graphics and text displays. The computer has a graphics display resolution of 640 × 400 pixels in eight different colors. The text and graphics can be overlaid while each is being individually colored.

A modular system, the *MB16001* has a separate system box, keyboard and CRT. If the buyer opts for the color CRT, it can display 2,000 characters in 15 different textual colors.

The 96-key keyboard features a numeric keypad for quick numerical data entry and 16 special function keys.

Quite a capable system, mass storage is via quad-density 5¼-inch minifloppy disk drives. This gives this personal computer the potential of nearly 700K of mass storage. This feature permits large amounts of storage for data processing.

The *MB16001* is equipped with one parallel printer port and

will support communications (or other serial peripherals) through an RS-232C serial port. It comes equipped with a light pen as part of this MS/DOS machine. Under this DOS, the system will run a BASIC interpreter, FORTRAN, COBOL, Pascal or assembler software. Five built-in slots on the motherboard provide for further system expansion.

New systems appearing from manufacturers already mentioned in this supplement include another two from Digital and one from Radio Shack, the *TRS-80 Model II*.

Digital Equipment Corp.

DEC's \$3740 *DECmate II* is actually an update and upgrade of an existing word processing system. This is one of the computers that makes use of something other than an eight-bit CPU, in this case a proprietary 12-bit CPU, the 6102. It also uses Digital's proprietary COS as its operating system.

One of the three modular systems released in the middle of this year, the *DECmate II* can easily interchange system pieces with either the *Rainbow 100* or the *Professional* series, which will be described shortly.

Because it is now limited to using DEC's operating system, this system can't take advantage of the many CP/M-based software packages on the market. However, this should soon be remedied as DEC has plans for a Z80 upgrade.

Since this is a modular system, the buyer will find a separate system box, display and keyboard. The 103-key keyboard includes special function keys and a keypad for rapid numerical data entry. This system also includes a bootstrap diagnostic routine that will inform the user of trouble in any area of the system on power-up.

This 12-bit system has 64K of standard RAM. This should be more than enough for any task this system will be called upon to perform.

Mass storage is via dual quad-density 5¼-inch minifloppy disks. This allows the user to have access to nearly 800K of mass storage. It should also work well with this proprietary 12-bit processor in allowing the user to do a great deal of work.

Quite frankly, this system was designed for professional word processing applications and in those applications this system should easily fill the bill, especially with the amount of mass storage available. However, this business orientation does limit programming language availability to DIBOL, DEC's own business oriented language.

The standard CRT is a high-resolution black and white monitor that is easily detached from the system and can be placed wherever the operator feels most comfortable. This is a good feature.

DEC's other system in this price range is the *Professional 325*. That unit sells for \$3995.

The *Professional 325* is driven by a 16-bit proprietary CPU called the F-11. As an example of its potential power, its instruction set is actually that of DEC's powerful PDP-11/23 series. Thus, this system is easily able to work as a standalone or as part of a wider DEC-based system. It will easily recognize and work with other DEC systems.

Quite frankly, according to the manufacturer, the *Professional 325* is aimed at the small business or office. In light of this, it's easy to understand why DEC chose to give the user the greatest amount of RAM available as standard on the market, 256K. This three-piece, modular system is quite capable of multitasking.

Standard mass storage is 800K on dual-density 5¼-inch floppy disk and there is a Winchester 5¼-inch hard disk drive available that will provide 5 megabytes.

This computer probably has the best graphics capability on the market. It has a display resolution of 960 × 240 pixels and will generate eight basic colors, or a total of 256 shades. The cursor is addressable.

Both of the DEC systems can interface with peripheral equipment through either serial or parallel ports.

An interesting feature of this series is the HELP key. This allows the user to address a ROM-resident HELP program and

menus. The DO key executes a function without the need to return to the special function keys. Also ROM-resident is a bootstrap diagnostic program that will tell the user if any part of the system has failed.

The operating system of this system is the company's proprietary P-OS. With this operating system, the user is able to run such high-level languages as the MBASIC Compiler and the Mark Williams' Co. C Compiler. It will also address FORTRAN and UCSD-p-Pascal. The keyboard is the same one common to the DEC personal computers.

Radio Shack

From Radio Shack comes the *TRS-80 Model II*, with two versions available in this price category, the 48K, one disk-drive model for \$3450 and the 64K, one disk-drive model for \$3899.

Driven by a 4 MHz Z80A, this system is powerful even in its most basic configuration. In that standard configuration, this system comes equipped with 48K of standard RAM, but this can be upgraded to 64K.

It is capable of creating the industry standard IBM-3741-format single-density disks with a Reformatter software package. However, to use this software, the system requires 64K of RAM and two or more drives. Under the TRSDOS operating system, this computer is capable of supporting a 17K disk-based BASIC interpreter that features detailed error flagging and quick editing.

This language is capable of advanced string handling and full editing, as well as multidimensional arrays and error trapping. It is also capable of program line renumbering and hex and octal conversion, as well as direction and sequential access to data in disk files. It also has the ability to execute TRSDOS commands and then return to BASIC with the program and variables intact. It is also capable of calling machine language subroutines.

Among the basic features of the *TRS-80 Model II* are a 76-key keyboard that includes a numeric entry keypad. Keyboard keys include HOLD, ESCAPE, BREAK, CTRL, CAPS and REPEAT.

This is another of the all-in-one computers on the market and it includes a standard, 12-inch black and white CRT that is capable of displaying either the industry standard 80 × 24 lines or double-sized characters at 40 × 24-lines.

Mass storage is provided by a single, built-in double density eight-inch floppy disk drive. The disk is capable of holding 416K.

System expansion is aided by a parallel port and two RS-232C serial ports. This will allow system expansion to include print-



IDEAL FOR BUSINESS APPLICATIONS, the Radio Shack *TRS-80 Model II* is powerful in even its basic configuration.

ers, plotters, and digitizers. These ports also support communication with other computers. This computer also includes four bus slots for future expansion or for adding memory.

Intertec

The next system which makes its appearance in this category is Intertec Data System's \$3500 *SuperBrain SD*. In reality, this is a system upgrade of the *SuperBrain* line. This system, too, is another of the all-in-one computers on the market.

The key difference between this *Superbrain* and the others in the lineup is the amount of mass storage. Though this computer also uses 5¼-inch minifloppy disks, the drives are configured for 1.5 megabytes of storage using dual quad-density.

Still a dual-processor personal computer, this unit is driven by dual Z80's with clock speeds of 4 MHz. System RAM is a standard 64K, which is more than enough for speedy operation of the system's CP/M operating system. The system's high-level language is BASIC.

Like other dual-processor personal computers, the *Superbrain SD* uses one CPU for system work, while the other handles "housekeeping" chores such as the display and keyboard. This permits the primary CPU to devote all its capacity to processing data.

And, like the other *SuperBrain* models, the *SD* has a built-in 76-key keyboard and 18-key numeric keypad for quick data entry. The keyboard is also capable of generating the full 128 character ASCII set.

The standard 12-inch green phosphor CRT is capable of the industry standard 80 × 24-line display, and it interfaces with peripherals or can be used for communications via two built-in serial ports.

Cromemco

Micromainframe computers are available in all price categories, and \$3500 to \$4000 is no exception. From Cromemco comes the *System One* or *CS-1* for \$3995. Driven by a 4-MHz Z80 CPU, the *System One* is meant for either single or multi-users. It is expandable and comes with an eight-slot card cage so a user can easily expand the basic system.

Dual quad-density 5¼-inch floppy disk drives provide a user with 780K of mass storage. This feature alone makes this system powerful for either the single-user or in a multi-user environment.

The standard 64K of RAM is easily able to run the company's proprietary RDOS. Word-processing software is available with *Writemaster*. Software is also available for interfacing a light tablet and pen. There is also a database management system available. The *CS-1* will interface with a printer via a parallel port.

The power of this system is evident in the languages it is capable of supporting. A long list, those languages include Structured BASIC, FORTRAN, COBOL, C, RatFor and Lisp. This system can also support the UNIX-like CROMIX multi-user operating system.

continued on page 102

TABLE 8—\$3500-\$4000

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Apple Computer 20525 Mariani Ave. Cupertino, CA 95014	Apple III	\$3990	6502A	8 bits	SOS 1.1	BASIC, Pascal
Cromemco 280 Bernardo Ave. Mountain View, CA 94040	CS-1	\$3995	Z80A	8 bits	RDOS	COBOL, C, CROMIX, Structured BASIC, RATFOR, FORTRAN, LISP
Digital Equipment Corp. Maynard, MA 01754	Professional 325	\$3995	F-11 (PDP 11/23)	16 bits	P/OS	BASIC-Plus-2 FORTRAN, DiBOL UCSD p-Pascal
Digital Equipment Corp.	DECMate II	\$3740	proprietary	12 bits	CP/M, COS310, WPS8	DiBOL
Hitachi Sales Corp. 401 W. Artesia Compton, CA 90220	MB16001	\$3500	8088	16 bits	MS/DOS	BASIC, FORTRAN, Pascal, assembler
Intertec Data Systems 2300 Broad River Road Columbia, SC 29210	SuperBrain SD	\$3500	Z80	8 bits	CP/M	BASIC, other CP/M compatible
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	OSI C4P-DF-HR	\$3615	6502	8 bits	OS-65D	BASIC
M/A COM OSI	OSI C8P-DF-48K	\$3640	6502	8 bits	OS-65D	BASIC
M/A COM OSI	C8P-DF-HR	\$3850	6502	8 bits	OS-65D	BASIC
Micro Source 595 N. Clayton Rd. New Lebanon, OH 45345	M6000P	\$3900	Z80	8 bits	CP/M	BASIC, UNIX, other CP/M compatible
MicroTechnology Unlimited Box 12106 Raleigh, NC 27605	MTU 130-2D	\$3599	6502	8 bits	CODOS	BASIC, UCSD p- Pascal
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	NEC PC-8001	\$3740	uPD 780 c-1 (Z80-like)	8 bits	CP/M	BASIC, FORTRAN, Pascal, COBOL
NEC Home Elec.	NEC PC-8001	\$3984	uPD 780 c-1 (Z80-like)	8 bits	CP/M	BASIC, FORTRAN, Pascal, COBOL
North Star Computers 1440 Catalina San Leandro, CA 94577	North Star Advantage	\$3999	Z80	8 bits	CP/M, G-DOS	GBASIC, other CP/M compatible
Olivetti 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$3560	Z8001	16 bits	PCOS	BASIC
Olivetti	M-20	\$3789	Z8001	16 bits	PCOS	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model III	\$3972	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN, editor/assembler
Radio Shack	TRS-80 Model II	\$3450	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN, editor/assembler
Radio Shack	TRS-80 Model II	\$3899	Z80	8 bits	TRSDOS	COBOL, BASIC, FORTRAN, editor/assembler
Sony 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$3675	Z80A	8 bits	CP/M	BASIC, Pascal
Vector Graphics Inc. 500 N. Ventu Pk. Rd. Thousand Oaks, CA 91320	1600	\$3995	Z80	8 bits	CP/M	BASIC, FORTRAN, COBOL, other CP/M compatible

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
128K/dual 5¼-inch floppy disks		74 keys, 13-key keypad	serial	80 × 24 text, 280 × 192 graphics, 16 colors	12-inch green CRT
65K/dual 5¼-inch disks			parallel		
256K/dual 5¼-inch floppy disks		103 keys	serial, parallel	80 × 24	12-inch display
96K/dual 5¼-inch floppy disks		103 keys	serial	80 × 24	12-inch display
128K/dual 5¼-inch floppy disks		96 keys	serial, parallel	80 (40) × 24 text, up to 640 × 400 graphics	12-inch monochrome or color display
64K/dual 5¼-inch floppy disks		80 keys	2 serial	80 × 24	12-inch green display
24K/dual 8-inch floppy disks			serial, parallel	256 × 512 color graphics	
48K/dual 8-inch floppy disks			serial, parallel	256 × 512 color graphics	
48K/dual 8-inch floppy disks			serial, parallel	256 × 512 color graphics	8-slot mother board
64K dual 5¼-inch floppy disks		standard	serial, parallel	80 × 24	9-inch display
80K/dual 8-inch floppy disks		96 keys, 8 programmable	1 serial, 2 parallel	80 × 24	12-inch green display
64K/dual 5¼-inch floppy disks		84 keys, 5 user-definable	serial, parallel		12-inch color display
96K/dual 5¼-inch floppy disks		84 keys, 5 user-definable	serial, parallel	80 × 24 text, 160 × 100 graphics	12-inch color display
64K/dual 5¼-inch floppy disks		87 keys	serial, parallel	80 × 24	integral green display
128K/dual 5¼-inch floppy disks		72 keys	serial, parallel	80 × 25 text, 512 × 256 graphics	12-inch B&W display
160K/dual 5¼-inch floppy disks		72 keys	serial, parallel	80 × 25 text, 516 × 256 graphics	12-inch B&W display
48K/dual 5¼-inch floppy disks		65 keys, 12-key keypad	serial, parallel	64 (32) × 16	integral B&W display
48K/8-inch floppy disk		76 keys, 2 programmable	serial, parallel	80 (40) × 24	integral B&W display
64K/8-inch floppy disk		76 keys, 2 programmable	serial, parallel	80 (40) × 24	integral B&W display
64K triple 3½-inch micro-floppy disks		73 keys, 6 programmable	serial, parallel	80 × 24 text, up to 640 × 230 graphics	12-inch color display
64K/8-inch floppy disk		72 keys	serial, parallel	80 × 24	integral display

Other systems

System upgrades show the power that is built into personal computers. For instance, the *TRS-80 Model III*, when equipped with dual 5¼-inch drives that provides the user with up to 306K of mass storage (single-sided double-density) and a *Line Printer VI* printer, costs \$3655. This price, however, doesn't include a RAM upgrade from 48K to 64K.

MicroSource's *M6000P* portable, fully configured but without a Winchester hard disk, tops out at \$3900. This configuration includes 368K of mass storage on dual, single-sided, double-density minifloppy disks, and a CRT and keyboard.

The Olivetti *M-20* is now reaching its fully configured state. With the addition of a second dual quad-density 5¼-inch minifloppy disk, this 16-bit CPU-driven system costs \$3,560. This gives the user the potential of 640K of formatted storage. It also gives the user the full advantage of the 16-bit CPU.

System upgrades continue with MicroTechnology Unlimited's *MTU-130*. When this system is equipped with dual, eight-inch quad-density floppies, the mass storage of this system becomes 2 megabytes, quite a large amount of space. This amount of storage helps to make up for any shortcomings in the processing speed of its 1 MHz, 6502 CPU. The system now includes 80K of RAM, five expansion slots on the motherboard, 96-key keyboard, 12-inch green monitor, 2 parallel ports, and one serial port. It is now nearly fully configured, except for the MC68000 processor board option or a hard disk drive.

With the addition of a second single-sided, double-density 5¼-inch minifloppy disk, the price of the 128K RAM *Apple III* system rises to \$3990. The standard CPU on this system, as described earlier in this supplement, is a 1.8-MHz 6502A.

NEC's *PC-8000* upgrades twice in this price range. For \$3734, the buyer gets the Z80-like μ PD 780 C-1 processor with a 4 MHz clock speed. This version of the system includes 64K of RAM, dual single-sided, double-density disks for 280K of mass

storage, expansion slots, 84-key keyboard, and parallel and serial I/O ports. The key addition to this system is the high-resolution, 12-inch color monitor. Increasing the amount of RAM to 96K on the *PC-8000A*, the user will spend \$3984, but will also gain more power in the system.

With three microfloppy disk drives, the Sony *SMC-70* has its amount of mass storage increased to 840K. In the \$3675 version, the third drive has been added for greater storage. The basic system includes 64K of RAM, CP/M, a 73-key keyboard and five expansion slots.

M/A-COM-OSI has three system upgrades in this price range. The *4P-DF-HR* at \$3615 offers the buyer a 1 MHz eight-bit 6502 CPU with a slow 1-MHz clock speed. (This CPU is common to all OSI products.) This system features 24K of RAM, but 550K of mass storage on dual eight-inch floppy disks. The potential is there for a color video output, and the company provides interfacing capabilities for a cassette recorder, modem, and D/A converter. This system is capable of supporting a display resolution of 512 x 256.

OSI's *C8P-DF-48K* provides the same basic features as the *C4P*, but the amount of internal RAM is expanded to 48K. It is priced at \$3640.


And, the OSI *C8P-DF-HR*, at \$3850, is an upgrade of the *C8P-DF-48K* with the addition of an eight-slot bus for system expansion.

Even the Texas Instruments *TI-99/4A* has an entry in this price category at \$3524. This version of the 48K system includes a speech synthesizer module.

When you add a printer to the 64K, dual Z80 driven Heath/Zenith *Z90*, the cost of this system rises to \$3590. The *Z90* is one of the many all-in-one systems on the market. It includes a full keyboard and 12-inch black-and-white CRT in the same housing. It looks like the traditional computer terminal with which nearly everyone is familiar.

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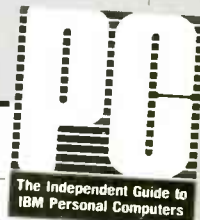
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Systems in this price range consist mainly of upgraded versions of basic systems. But for the added cost, you get versatility.

MARC STERN

FOR ONE REASON OR ANOTHER, IT SEEMS THAT THERE ARE relatively few computers priced between \$4000 and \$4500—most are either priced higher or lower. What's more, most of what's available are simply upgrades of lower priced systems.

One system that fits into this category is the Sharp YX3200, another of the many Z80-based personal computers on the market. That system sells for \$3495.00; adding the companion 80-column, bidirectional, dot-matrix printer, which sells for \$895.00, brings the price up to \$4390.00 for a fully configured system.

The YX3200 comes with 64K of RAM; ROM is expandable to 72K. Mass storage is handled using two double-sided, double-density 5¼-inch floppy-disk drives; those allow a potential of 284K of storage per drive. The computer uses either Sharp's own FDOS (FLOPPY Disk Operating System) or CP/M; both come standard with the system.

Included in the unit's 92-key keyboard are 10 user-definable keys and a numeric keypad for rapid data entry. Although we've commented on numeric keypads briefly in other parts of this section, their importance can't be underestimated. If you've ever had to enter long lists of numbers, you know what I mean. You certainly could do it using the numbers found on a standard typewriter-style keyboard, but the procedure is cumbersome when compared to using a numeric keypad. The keyboard, incidentally, is capable of producing the full ASCII character-set.

Standard with the system is a 12-inch green CRT display. The display can show up to 24 lines (actually 25, but one is a status line) of 80 characters each.

The unit also has five I/O ports to facilitate system expansion. Those can be used to add additional drives, for RS232C communications (the interfaces are included with the system), etc. A parallel port is provided for the printer.

TABLE 9—\$4000-\$4500

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Commodore Business Machines 487 Devon Pk. Rd. Wayne, PA 19087	CBM 8032	\$4084	6502	8 bits	proprietary	BASIC
Commodore Business Machines	SuperPET 9000	\$4085	6809/6502	8 bits	proprietary	APL, BASIC, Pascal, FORTRAN, assembler
Zenith Data Systems 100 Milwaukee Ave. 1 Glenview, IL 60025	Z90	\$4190	Z80	8 bits	HDOS, CP/M (optional) other CP/M compatible	BASIC, UCSD p-Pascal, FORTRAN,
IBM Information Systems P.O. Box 1328 Boca Raton, FL 33432	PC	\$4425	8088	16 bits	PCDOS, CP/M (optional)	BASIC Compiler, UCSD-Pascal IV, COBOL
Sharp Electronics 10 Keystone Pl. Paramus, NJ 07652	YX3200	\$4495	Z80A	8 bits	FDOS, CP/M	BASIC, other CP/M compatible
Sony Corp. 7 Mercedes Dr. Montvale, NJ 07645	SMC-70	\$4195	Z80A	8 bits	CP/M	BASIC Pascal, other CP/M compatible
Texas Instruments PO Box 225012 Dallas, TX 75265	TI-99/4A	\$4174	TMS9900	16 bits	proprietary	BASIC



EXPANSION MODULES for the Sony SMC-70. Along with the modules, the light pen and numeric keypad are shown.



THE ZENITH Z90 is an upgrade of the Z89. The terminal-type housing looks identical for both computers.

This system is designed with the user in mind. In addition to FDOS and CP/M, the system price includes CBASIC and Sharp BASIC programming languages. In addition, the YX3200 boasts what it calls "Automatic Program Generation." That allows a user with no knowledge of programming to create business forms in three steps. A series of prompts leads the user through

HARDWARE

\$4000-\$4500

the creation of the program with a series of graphics displays and yes/no answers—sort of a spreadsheet program with a built-in helping hand.

Other systems

The fully configured IBM *Personal Computer* (the more basic versions are described elsewhere in this section) also reaches this price level. At \$4425, the system includes a 16-bit 8088 CPU, 280K of disk storage, a 12-inch green CRT, and 128K of RAM. The key difference in this system is that the amount of RAM has been doubled.

Another system whose highest price falls in this range is the Sony SMC-70. In its maximum configuration, this system sells for \$4195.00 and includes three disk drives and 64K of RAM, permitting over 840K of mass storage. It also includes a 12-inch, high-resolution color monitor for color graphics.

The Texas Instruments TI-99/4A can also reach this range by adding a disk drive to the 48K system. That system, which also includes a printer, speech synthesizer, modem, and communications program package, sells for \$4174.00.

When you upgrade the Commodore Business Machines' 8032B business system to 96K of RAM and add a printer, its price rises to \$4085. Adding a printer to their *SuperPET SP9000*, which has 96K of built-in RAM, also increases the price to that figure. Complete descriptions of those systems can also be found elsewhere in this section.

And, by adding the \$995 printer to the Zenith Z90, the price of this system come up to \$4190. That computer is a dual processor Z80-based unit and features an integral keyboard and 12-inch monitor.

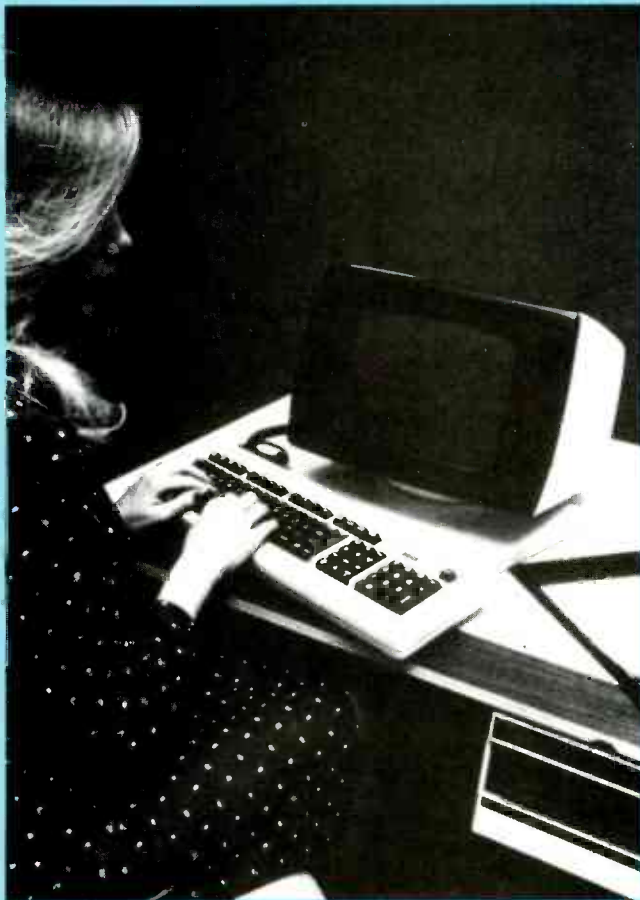
R-E

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
96K/dual 5¼-inch floppy disks		standard, numeric keypad	IEEE-488	80 × 25	printer, integral 12-inch B&W monitor
96K dual 5¼-inch floppy disks		standard, numeric keypad	IEEE-488	80 × 25	printer, integral 12-inch B&W monitor
64K 8-inch floppy disk		84 keys, 12 function keys	serial,	80 × 24 text, 33 graphics characters	printer, 12-inch B&W monitor
128K/dual 5¼-inch floppy disk		83 keys, 10-key keypad 10-special-function keys	serial, parallel	80 × 24	11½-inch green CRT
64K/dual 5¼-inch floppy disk		92 keys, 10 programmable	serial,	80 × 24	
64K/triple 3½-inch micro-floppy disk		72 keys, 5 programmable	serial, parallel	80 × text, 640 × 230 graphics	
48K/5¼-inch floppy disk		standard	serial	32 × 24 text, 192 × 256 graphics	printer

\$4500-\$6000

There are many computers to choose from in this price range. Many new systems make their first appearance here and many systems reach their maximum expansion and full potential.

MARC STERN



WHEN YOU REACH THE HIGH END OF THE PERSONAL COMPUTER spectrum, the competition really begins to get lively. Many new computer systems make their first appearance in this category. Also included in this category are those systems that have been steadily improving in power and performance as they have become more expensive.

A minimum of 10 new systems make their first appearance in this price category, with the names of such computer manufacturers as Altos, Vector Graphic and Zenith joining the list of manufacturers offering high-end systems. (Zenith is the parent of Heath, which offers the Heath/Zenith series.) Canon, long known in the consumer photography and electronics fields, has also brought out its own computer system, while Hewlett-Packard's HP-87 series reaches its most powerful level in this spectrum.

Canon

Taking a look at the \$4995 Canon CX-1, we find it is driven by an eight-bit 6809 CPU. The system comes with 64K RAM as

standard, which is more than enough user memory to allow this system to access and retrieve data quite quickly. This operating system is Canon's proprietary Floppy Disk Operating System and it supports the BASIC, Assembler and ANSI COBOL programming languages.

This system is frankly aimed at the business market and because it comes as an all-in-one unit. The terminal contains an 84-key keyboard, that includes a 14-key function/numeric keypad, dual 5¼-inch minifloppy disk drives and a 12-inch green phosphor CRT.

Interestingly, the keyboard is a dual-mode unit. In one mode it is a full ASCII keyboard, capable of generating the entire 96-character ASCII set, while in the other mode it is a programming keyboard with one-key functions for such BASIC language programming commands as GET, PUT, GOSUB, CLOSE, DIM. Those functions are spelled out on legends on the front of the keys.

Mass storage is accomplished via dual double-sided, double-density minifloppy disks that are capable of storing up to 320K per disk.

The CRT's display is the industry-standard 80 columns (characters) by 24 lines and the system is capable of displaying 32 graphic characters and special symbols.

Hewlett-Packard

Hewlett-Packard's HP-87 personal computer becomes quite a powerful system in this price category. Like other personal computers, this one has its origins in the sub-\$2500 category. However, as it climbs through the price spectrum its power builds until it reaches \$5190.

At this price level, the system includes an 80-series 8-bit processor, along with the CP/M operating system. This means the user has access to the wide variety of software available that runs under CP/M, while, at the same time, having access to software which runs solely under Hewlett-Packard's proprietary operating system.

This system has a total of 112K of system RAM, which is more than enough to allow this system to take advantage of the full power and speed of both the 80-series CPU and the Z80 CPU and CP/M. A total of 540K of mass storage is available on two 5¼-inch double-density minifloppy disks.

Vector Graphics

The Vector Graphics 2600 is another system that makes its first appearance in this price category. At \$5195, this system packs a great deal of power. For starters, this system uses a fast clock speed of 6 MHz to drive its eight-bit Z80 CPU. This means it can handle just about any task thrown at it with high speed. When this is combined with the bank-switched 64K of standard RAM, you can see this system has a great deal of capability.

The reason that bank-switched memory is attractive is because the computer's operating system is loaded into one bank of memory, leaving the second bank of memory nearly free for user access. (This reduces the amount of disk access time and allows

printing while the system is handling other functions.)

This system operates under one of the later versions of CP/M, version 2.5. Because it does, the user has access to the many programs written for this nearly universal operating system. The user also has access to such high-level programming languages as a BASIC Compiler, which runs more quickly than a BASIC Interpreter program, FORTRAN, COBOL, Pascal, RAID (a program debugger), Scope (a word processor) and BASIC 80. As you can see, this system is equipped to handle just about any task a user may think up.

The key upgrade in the Vector 2600 is the increase in the amount of mass storage. Still residing on two 5¼-inch minifloppy disks, mass storage now rises to 1.2 MB on 80-track dual quad-density disks. This amount of storage is ideal for business, scientific or personal computer applications.

Equipped with a standard 72-key keyboard, this system also includes a 10-key numeric pad for rapid data entry. It interfaces with peripherals via three parallel or one serial port. The 12-inch CRT is capable of the industry standard 80 × 24 display. This display is bit-mapped which allows a user to have direct access to the display memory and allows the use of customized graphics.

The Vector 2600 is another of the all-in-one personal computers on the market. It includes the keyboard, CRT and system box in one terminal.

Zenith

Zenith has a new entry in this price category, its new Z-100, another of the 16/8-bit dual-processor personal computers now appearing on the market. It is also an all-in-one personal computer. The Heath Company will also be offering a kit version of this computer.

This new system gives the user the advantage of both eight-bit and 16-bit power with an 8085 eight-bit CPU and a 16-bit 8088. The operating systems to which the user has access are CP/M and Z-DOS. This system is compatible with the IBM's PC-DOS operating system. In addition, the floppy disk format is also compatible with IBM's format so that floppy disks containing software for the IBM computer will run directly on the new Z-100 and thus providing access to the rapidly expanding domain of IBM personal computer software.

The under-\$5000—pricing hadn't been established at press time—Z-100 system is full-featured, with 128K of standard RAM, or more than enough for all but the most ambitious data base management or spreadsheet routines. This RAM is expandable to 192K on the main processor board and will expand to 768K through the use of the built-in expansion slots in the system area.

Standard mass storage is via dual quad-density 320K built-in 5¼-inch minifloppy disks. Eight-inch floppies and a Winchester hard-disk drive with 5 megabytes of storage will be available as options.

The system offers two versions of BASIC—BASIC-85 and Z-BASIC. The Z-BASIC is an enhanced version that includes many color-graphic commands. The 108-key keyboard includes 13 user-definable special-function keys.

The standard monochromatic screen is capable of the standard 80 × 24 display, while an optional color monitor is also available. This system is capable of generating high-level color graphics with a resolution of 225 lines × 640 dots. It is also capable of resolution of up to 500 lines. An RGB color signal is available at the rear panel.

The Z-100 is capable of both asynchronous and synchronous (as well as half- and full-duplex) communications and the system will interface with peripherals via either two serial ports or one parallel port.

Billings

The \$4700 Billings 500-series is another new entry from the Billing Computer Corp. This all-in-one system is also equipped with an eight-bit Z80 CPU. Mass storage is via either 5¼-inch



HARDWARE
\$4500-\$6000

minifloppy disks or eight-inch floppies. The minifloppies are quad-density and are capable of up to 360K of storage per drive. Standard RAM for this system is 64K and it is capable of either acting as a stand-alone computer or part of a computer network.

This is a user-friendly system that practices what is called by the company "Computomatics." Under this system, a series of English language prompts and menus, combined with function keys, will guide the user through the system's operation.

Those 16 function-keys are included on the detachable 94-key keyboard that also includes a numeric keypad. The system interfaces with peripherals via either serial or parallel ports.

CMC International

CMC International Corp.'s *SuperFive* is, in reality, based on Intertec Data Systems' *SuperBrain* series mentioned previously. In fact, it is the equivalent of the *SuperBrain Sr.*, which includes a single, quad-density 5¼-inch minifloppy for mass storage and a 5¼-inch mini-Winchester hard drive for another 5 megabytes of storage. This comes standard in CMC's *SuperFive 1*.

Quasar Data Products

Micromainframes systems still abound in this category realm with the \$4695 Quasar Data Products *QDP-100*. This Z80-driven, 4-MHz system supports CP/M (multi-user) and will support the Oasis operating system (multi-user, multi-tasking). The standard RAM for this system is 64K of bank-selectable RAM. This is included on a board with a second clock speed of 5 MHz.

Since this is the heart of an expandable system, there are two serial and two parallel ports to interface with such user options as the CRT or printer. Storage is via dual quad-density, 5¼-inch minifloppy disks.

Altos Computers

One Altos ACS 8000-2 makes its debut in this category. Although it is still a micromainframe system—a standalone system box with the user supplying accessory expansion cards and other peripherals such as CRT's and printers—when configured with the Altos 1 smart terminal, the cost of this system is \$4645. In this configuration, the user has a full-featured, very powerful system.

Driven by an eight-bit Z80 CPU, this system recognizes the industry-standard CP/M operating system. Its standard RAM of 64K is capable of supporting not only that operating system, but also the languages this system is capable of running—FORTRAN-80, COBOL, PASCAL, APL, and PL/1. Those are high-level systems-oriented programming languages and display the power of this system.

This system is capable of 1 megabyte of storage via a pair of single-sided, double-density integral floppy disks and it interfaces with its peripherals via either a pair of fully implemented, RS-232C serial ports or one programmable eight-bit port.

The keyboard of the smart terminal linked to this system is a

TABLE 10—\$4500- +

Manufacturer	Model	Price	CPU	Word Length	Disk Operating System(s)	Language(s)
Altos Computers 2360 Beving Dr. San Jose, CA 95131	ACS 8000-2	\$4545	Z80	8 bits	CP/M	FORTRAN-80, APL, COBOL, Pascal, PL/1, other CP/M compatible
Billings Comp. Corp. 18600 E. 37th Independence, MO 64057	Billings 500	\$4700	Z80	8 bits	proprietary	N/A
Canon USA One Canon Plaza Lake Success, NY 11042	CX-1	\$4995	6809	8 bits	proprietary	BASIC, assembler COBOL
Hewlett-Packard 1820 Embaradero Rd. Palo Alto, CA 94303	HP-87	\$5190	Z80	8 bits	proprietary, CP/M	BASIC, CP/M compatible
IBM PO Box 1328 Boca Raton, FL 33432	IBM Personal Computer	\$5196	8088	16 bits	DOS 1.1, CP/M (optional)	BASIC, other CP/M compatible
Imsei Computer Div. Fischer-Freitas Corp. 910 81st Ave. Oakland, CA 94621	PCS-4410	\$5250	8085	8 bits	IMDOS, CP/M	BASIC, other CP/M compatible
IMS Internat'l 2800 Lockheed Way Carson City, NV 89701	5000SX	\$5170	Z80A	8 bits	CP/M, MP/M, TurboDOS	
M/A COM OSI 7 Oak Pk. Bedford, MA 01730	230C	\$4890	6502	8 bits	OS-65	N/A
Micro Computer Technology 3304 W. MacArthur Blvd. Santa Ana, CA 92704	Model III	\$5399	Z80	8 bits	LDOS, DOS, TRDOS, NEWDOS 80	
MicroSource 395 N. Clayton Rd. New Lebanon, OH 45345	M6000P	\$4795	Z80	8 bits	CP/M	BASIC, UNIX
MicroTechnology Box 12106 Raleigh, NC 27605	MTU-130-2D	\$4593	650	8 bits	CODOS	BASIC, UCSD Pascal
NEC Home Elec. 1401 W. Estes Ave. Oak Grove, IL 60007	PG-8001	\$4814	uPD 780 c-1 (Z80-like)	8 bits	proprietary	BASIC, COBOL, FORTRAN, Pascal
Olivetti 155 White Plains Rd. Tarrytown, NY 10591	M-20	\$5489	Z8001	16 bits	PCOS	BASIC
Radio Shack One Tandy Center Fort Worth, TX 76102	TRS-80 Model 16	\$5798	MC68000	16/ 8 bits	proprietary/ TRSDOS	
Smoke Signal Broadcasting 31336 via Colinas Westlake Village, CA 91362	Chleffain 9524	\$5229	6809	8 bits		
Systems Group 1601 W Oranewood Orange, CA 92668	System 2814	\$5609	Z80	8 bits	CP/M, MP/M, Oasis	
Vector Graphic 500 N. Ventura Pk. Rd. Thousand Oaks, CA 91320	Vector 2600	\$5195	Z80	8 bits	CP/M	BASIC, FORTRAN, COBOL, Pascal, other CP/M compatible
Xerox 1341 Mockingbird La. Dallas, TX 75247	820II	\$4895	Z80	8 bits	CP/M	CBASIC, MBASIC, COBOL, other CP/M compatible
Zenith Data Systems 100 Milwaukee Ave. Glenview, IL 60025	Z-89	\$4890	Z80	8 bits	HDOS, CP/M	BASIC, FORTRAN, COBOL, UCSD p- Pascal, CP/M compatible
Zenith Data Systems	Z-100	under \$5000	8088	16 bits	MS-DOS, CP/M-86	BASIC

Memory/Storage	Expansion	Keyboard	I/O	Display	Comments
64K/dual 8-inch disks-1MB		105 keys, 8-special function	serial, parallel	80 × 24	12-inch green display
64K/dual 5¼-inch floppy disks			serial, parallel	80 × 24	green display
64K/dual 5¼-inch floppy disks		standard, numeric keypad	serial, parallel	80 × 24 text, 32 graphic symbols	
112K/dual 5¼-inch floppy disks					Z80 card added
256K/dual 5¼-inch floppy disks					other features unchanged
64K/5¼-inch floppy disk, 10 MB hard disk					see PCS-42
64K/dual 5¼-inch floppy disks					
48K/dual 8-inch floppy disks			serial		
48K/5¼-inch floppy disks, 5.7 MB hard disk				64 (32) × 16	
64K/dual 5¼-inch floppy disk, 5 MB hard disk		standard	serial	80 × 24	9-inch green display
80K/dual 8-inch floppy disks	MC86000 card adds 256K RAM	96 keys, 8 programmable	2 serial, 1 parallel	80 × 24	12-inch green display
160K/dual 5¼-inch floppy disks		84 keys	serial, parallel	80 × 24 text, 160 × 100 graphics	12-inch color display
160K/dual 5¼-inch floppy disks		72 keys	serial, parallel	512 × 256 graphics	12-inch color display
128K/dual 8-inch floppy disks		76 key keypad, special-function keys	serial, parallel	80 (40) × 24	12-inch green display
64K/dual 5¼-inch floppy disks					micro-mainframe
64K/dual-quad-density floppy disks			4 serial, 2 parallel		
64K/dual 5¼-inch floppy disks		72 keys, 10 key keypad	3 serial, 1 parallel	80 × 24	12-inch display
64K/dual 8-inch floppy disks		96 keys	2 serial, 2 parallel	80 × 24	12-inch display
48K/dual quad-density 5¼-inch floppy disks		84 keys, 12 key keypad	3 serial, 1 parallel	80 × 24	integral display
108K/dual 5¼-inch floppy disks		108 keys, 13 special function, 12-key keypad	serial, parallel	80 × 24 text, 640 × 500 color graphics	

105-key unit with eight function-keys. The display is a 12-inch green phosphor CRT capable of generating the industry-standard 80 × 24 display.

Systems Group

Two computer systems similar to the Altos system are offered by the Systems Group, the S3035 *System 2812* and the \$5,609 *System 2814*. Both computers contain an eight-bit Z80 CPU that is driven by a 4-MHz clock signal and both computers are capable of operating under CP/M, MP/M and Oasis. Two single-sided, double-density or double-sided, double-density disks provide up to 1.2 megabytes of mass storage. This system interfaces with peripherals via either parallel or serial ports. In such a system, the user provides the optional peripherals.

Imsai

The same is true of the Imsai series available at this price level. These computers are micromainframes driven by 2-MHz eight-bit 8080 CPU's, the \$4850 *PCS-4450*, the \$5250 *PCS-4410* and the \$5750 *PCS-4418*, provide system upgrades over the basic Imsai systems. The key upgrades for the *4450* is the addition of a 5-megabyte 5¼-inch Winchester hard disk, while the *4410* upgrades with a 10-megabyte Winchester hard disk. The *4418* has a 5¼-inch, 18-megabyte Winchester drive.

M/A Com OSI

Another micromainframe system that also appears in this price category is the M/A Com-OSI *230C10*. Driven by a 1 MHz, eight-bit 6502 CPU, this \$4890 micromainframe computer is also the heart of a system. In the system box is 48K of RAM and dual, single-density eight-inch floppy disks that are capable of 275K of storage. The operating system is the company's proprietary OS-65.

Radio-Shack

In this price category appears Radio-Shack with its *Model 16*, the most powerful computer Radio-Shack has ever introduced. This is another of the combination 16/8-bit systems that have recently come onto the market. And, it seems that each one has a different 16-bit CPU and a different eight-bit CPU.

Making early use of the 16-bit MC68000 CPU. Radio-Shack's *Model 16*, also uses an eight-bit Z80. Both are high-speed processors with the 68000 running at 6 MHz and the Z80 running at 4 MHz.

As in other systems, the 8-bit processor—the Z80—handles the "housekeeping" for the 16-bit CPU. These chores include I/O and this design permits the *Model 16* to use much more money and to process data at much higher speeds than other eight-bit micros on the market.

This system comes with 128K of standard RAM that can be expanded in 128K increments to 512K, and it is software compatible with the existing *Model II* system. This is especially important for the Radio Shack *Model II* owner who may be upgrading his system to the *Model 16* and may have a sizeable investment in a *Model II* software library.

Along with being software compatible with the *Model II*, the *Model 16* operating system includes an editor/ assembler software package for assembly language program development. The editor allows extensive and sophisticated editing techniques and it is both line and character-oriented. The editor/ assembler package is supplied on the system disk and includes an editor, micro-assembler, linking loader, cross-reference and debugger.

The keyboard is a 76-key professional unit and includes a numeric keypad. The display is a 12-inch standard green CRT that is capable of the industry standard 80 × 24 or double-sized 40 × 24 lines. Mass storage is available on one or two built-in quad-density eight-inch floppy disks. In the one-disk version with 1.2 megabytes of mass storage, the price is \$4999 and in the two-disk version, the price is \$5798. This system will interface with peripherals via a standard parallel port or two serial RS-232C ports.

Other systems

Into this price category also fall many other systems that reach their fully configured state. For instance, the Heath-Zenith Z-89's price climbs to \$4890 when it is equipped with dual double-density 8-inch drives. It still retains its 48K of internal RAM. However, when this system upgrades to 64K and becomes the Z-90, the price increases to \$5190. (A full description of this system was given earlier.)

When two 8-inch disks are added to the Xerox *820 II*, the system's price rises to \$4895, while when a 5-megabyte 5¼-inch Winchester disk drive is added to the MicroSource *M6000P*, the price rises to \$4795. (Please refer to previous description of these systems.)

Olivetti's *M-20*, the first system to make use of the 16-bit Z8001 CPU, also reaches its nearly fully \$5480 configured state with the expansion of system RAM from 128K to 160K. And, it is even further expandable. This system includes dual quad-density 5¼-inch minifloppy disks for mass storage. (Please refer to the previous description of the basic system.)

The \$4598 MicroTechnology *MTU-130-2D* is the fully configured system with the addition of 256K of RAM and an 8-MHz MC68000, 16-bit processor board. This gives this 1-MHz, 6502 system 16/8-bit capability. However, it should be noted the 68000 must interface with the relatively slow 6502, so processing time may be slowed.

Even Digital Equipment Corp. has a system upgrade in this price spectrum, the *Professional 350*. This is an upgrade of the 325 and adds an internal 5¼-inch Winchester hard disk drive as well as improved graphics.

In its fully configured state, the Commodore *CBM 8032*, with dual disk drive and a dot matrix printer costs \$5040, as does the *CBM SuperPet SP9000* in the same configuration.

And even the Texas Instruments *TI-99/4A* tops out at a price of \$5074 with two disk drives, 48K of RAM, a printer and both communications, voice and high-level video output. (Please refer to the earlier descriptions of these systems.)

These aren't all the systems available for under \$6000, our cutoff point. For instance, A. B. Dick's *Magnawriter* is listed at \$5995 and it is driven by an eight-bit 8085 CPU. Then there's Alpha Microsystem's personal, also driven by an MC68000 16-bit processor.

The Archives Inc.'s *Model I*, driven by an eight-bit Z80A, is priced at \$5500, while the California Computer Systems' *System 300-3*—with terminal—costs \$5450. The *964 Plus* by Columbia Data is also driven by a Z80A eight-bit CPU and includes dual 5¼-inch minifloppy disk storage at \$4995. The Corvus' *Concept*—one of the few MC68000 driven systems that has 512K of RAM and 2.4 megabytes of mass storage on quad-density eight-inch disks is bargain priced at \$5000. This is also one of the most powerful personal systems to date on the market.

The Dynabyte model *5305*—another micromainframe—is priced at \$5690 with two eight-inch double-density floppy disk drives. The Fortune Systems' *32/16*, MC68000 16-bit CPU system, is priced at \$5995.

In its maximum configuration, the IBM *Personal Computer*, is priced at \$5196. This price includes maximum RAM expansion to 256K and dual double-density minifloppies.

Another system which reaches full power in this price range is the \$5170 IMS International *5000SX* with terminal. Another of the Z80A-driven systems, this one includes dual 5¼-inch minifloppies and 64K of RAM.

Micro Computer Technology Inc. takes the Radio Shack *Model III* and increases the mass storage capacity by several orders of magnitude. For \$5399, a buyer gets the 48K *Model III* and a 5¼-inch Winchester hard disk which yields 5.7 megabytes of storage. This is combined with a quad-density 5¼-inch minifloppy.

In its maximum configuration, the NEC *PC8001* reaches a powerful level. For \$4814, the user gets 160K of RAM, 320K of storage on dual, double-density 5¼-inch minifloppies and the high-resolution color monitor. R-E

8-bits

VS.

16-bits



JOSEF BERNARD
TECHNICAL EDITOR

YOU'VE CERTAINLY READ OR HEARD OF 8-BIT OR 16-BIT COMPUTERS, but what exactly do the terms mean? Let's start at the beginning.

A *bit*, if you're not already familiar with its definition, stands for a *Binary digit*, the presence or absence of an electrical signal within a logic or computer circuit, and represents a "yes" or "no," "on" or "off," "logic-1" or "logic-0" condition. By itself, a bit can convey little information—it's either there or it isn't. Collections of bits, however, with the bits lined up "side-by-side," can do a lot more.

Two bits, in their various on/off combinations, can represent four numbers: zero, one, two or three. Add another bit, and you have eight different combinations available to give you the numbers zero through seven. Eight bits will give you 256 possible combinations; sixteen bits, 65,536 combinations.

Since each bit can represent only one of two values—zero or one—we are restricted to working with the numbers that can be built using *powers of two*. That's where the word "binary" comes in—it refers to the two states that a bit can be in. If we liked, we could consider each bit to have a value of either zero or two, and add them together in longer and longer strings to get the values we needed. It makes a lot more sense, though, to allow each bit-position to represent a power of two (see Fig. 1). Thus, the first bit-position represents either zero or 2^0 , or 1. The second position would be 2^1 , or 2 (for now we'll ignore the cases where no bit is present—that's always zero).

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	1	1
128	64	32	16	8	4	2	1

FIG. 1—LOGIC-HIGH BITS are traditionally represented by "1"s; logic-lows by "0"s. Binary numbers are read from right to left; the digit with the lowest value is at the right.

The third bit would represent 2^2 , or 4, and the fourth 2^3 , or 8. If we had a 4-bit number where all the bits were "high" (present), that number would be equal to 15, the sum of $2^0 + 2^1 + 2^2 + 2^3$. Of course, not all the bits have to be high. If bit-2 were "low" (equal to "zero"), the sum of the binary digits would be 13, and so on.

In computers, and other logic circuits, a "high" bit is usually represented by an electrical value of close to five volts; a "low" bit is close to zero volts. A microprocessor is set up to look for a specific number of bits. An eight-bit microprocessor will have eight lines available for binary data. It will always look for eight bits, arranged side-by-side. If some of those bits are zeroes, it will take that into account and count only the "high" ones but, nonetheless, it will still have to account for all eight bits. A sixteen-bit microprocessor will always look for a string of sixteen bits.

The latest upheaval in the microcomputer revolution is the introduction of 16-bit computers. What makes them different, and are they for you?

The important thing to remember is that a microprocessor is always looking out of a window that's so-many-bits wide; an eight-bit microprocessor will always look for the combined value of eight bits at once—whether they're high or low—and a sixteen-bit one will do the same for a sixteen-bit *word* (a word is a binary number made up of a fixed number of bits—that's why we speak of eight- or sixteen-bit-word systems).

To finish up this discussion of terminology, a 4-bit word is called a *nybble*, an 8-bit word a *byte*, and a 16-bit word is... well... a 16-bit, or double-byte, word.

Microprocessors and word-lengths

The first microprocessors, like the 4004, 4040, and SC/MP were 4-bit devices—not really useful for practical computing. In fact, they were originally designed for use in programmable calculators...but for various reasons that plan was never completed. Some simple computers were built using them, but they found their greatest use in microprocessor-controlled appliances and in other applications that could benefit from a microprocessor, but that required only a limited amount of "smarts."

The 4-bit devices were quickly followed by much more sophisticated 8-bit microprocessors such as the 8008 and 8080 (used in such computers as the *Altair* and *Insai*) and the 6800, which was adopted by SWTP (Southwest Technical Products) and Midwest Scientific, among others. A second generation of 8-bit devices followed close on their heels; included in that group were the 6502, used in the *Apple II* and many Commodore computers, and the Z80, used by—to name only one of many—Radio Shack's *TRS-80*.

Among the most popular microprocessors were the 8080 and the Z80, and a powerful disk operating-system, *CP/M*, which was developed to run on systems using those microprocessors, gained popularity. (It is compatible with both microprocessors because the Z80 "understands" all the instructions used by the 8080. The same holds for the 8085, an enhanced version of the 8080.)

For a long time—as microcomputer history goes—those 8-bit

microprocessors dominated the market. There were a couple of 16-bit CPU's (Central Processing Units—another term for "microprocessor") around—Texas Instruments' TMS9900 and Western Digital's WD16—but they found limited use because most microcomputers were set up to handle only 8-bit devices.

Then, in 1978, announcements were made of a number of new 16-bit microprocessors—the 68000 from Motorola, the Z8000 from Zilog and the 8086 (and later the 8088) from Intel. Potential microcomputer owners began asking themselves whether they shouldn't wait until computers using them became available; after all, they would be much more powerful.

8-bit computers

As we mentioned earlier, computers using 8-bit microprocessors turned out to dominate the market. The main reason for that was that, as the microcomputer market was exploding, the most powerful CPU's were the 8-bit units—16-biters were still on the drawing board or in the testing stage.

Consequently, languages, operating systems, and programs all were written using 8-bit words. A tremendous library of 8-bit material grew up and, as time went on, the 8-bit languages and programs became more and more sophisticated (a term frequently used in "computerese" to mean "complex and versatile"), and there arose a number of extremely useful programs (and even more next-to-useless ones).

There are programs written for 8-bit computers that will do almost anything you need your computer to help you with. (This article was written on an 8-bit computer running a word-processing program). Some programs are more efficient than others, but that is due mainly to the skills the programmer applied to his work and, perhaps, to the languages in which they were written.

If 8-bit software (programs) and hardware (computers) are capable of so much, then, why then do we need 16-bit machines?

8 bits vs. 16 bits

Mainframe computers—the big ones—use word lengths of 16 bits, 32 bits, or greater and, we must admit, are more powerful than our 8-bit micros. What makes them more powerful? There are several factors.

The first is that while an 8-bit microprocessor can recognize a maximum of 256 different instructions (they're never all used—the Z80, which probably has the most comprehensive instruction-set, uses only 158), a 16-bit CPU can recognize over 65,000 instructions (also not all used). Many of the instructions for 8-bit computers, though, require several 8-bit words, one after the other. That requires the computer to go through several cycles to perform a single operation.

In a 16-bit machine, multiple-byte instructions can be presented to the computer all at once, which means that several time-consuming (even when you're working in microseconds—millionths of a second—time continues to fly) instructions can be swallowed all in one gulp, and the computing process speeded up considerably.

At the other end of the microprocessor, where data is transferred to and from memory, again, a longer word length makes for more efficiency. Possibly even more important is the fact that, while 8-bit processors can directly address 65,536 memory locations, 16-bit processors can directly address *millions* of memory locations.

That means that, as programs become more complex, and require more storage space for themselves and for the data they process, a computer using a longer word-length can operate more quickly. There's the real reason for interest in 16-bit computers—*speed!*

To take advantage of the best of both worlds, a number of recent computers contain both 8-bit and 16-bit microprocessors (see Fig. 2). That generally means that they can run both "old" (but valuable) programs written for 8-bit computers as well as new 16-bit releases.

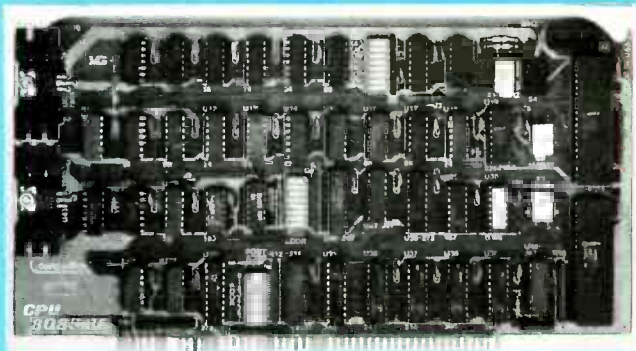


FIG. 2—A DUAL-PROCESSOR board, such as this one from CompuPro, allows the use of both 8-bit and 16-bit software.

Do you need sixteen bits?

We always like to think that more or faster is better. The Concorde will get us to London in less than half the time that it would take on a 747. But is there any reason for most of us to pay the price to save those extra few hours?

Similarly, eight bits are better than four and sixteen bits are better than eight. But is that really the case? My 8-bit computer can manipulate the words I am setting down more rapidly than I can think of them or enter them from my keyboard. Do I need a computer that will work still faster, even though I can't? The answer is an obvious "no."

I don't even need a faster computer to run an action-game program if my reflexes are slower than the computer's. What good, then, is a faster computer? The first modern computers—vintage World War 2—were created to calculate the trajectories of artillery fire. Obviously, the faster and more accurately those could be determined, the better the results.

The performance of difficult and complex calculations, like those just mentioned, or even of simple but repetitive ones, is called *number crunching*. And number crunching is not restricted to just military applications.

For example, there are programs for home or commercial use that require the solving of complex equations or the performance of the same type of calculations over and over (like calculating payroll deductions). Obviously, the faster the computer can perform the task, the more work it can do in a given time—and the sooner the results will be obtained. While that may not have a great impact on your personal life, in business, time is money. Also, very large numbers can be handled more easily and accurately by a 16-bit machine than by an 8-bit one because of the longer word-size.

Furthermore, since computers are frequently used to store and rearrange other types of data than numbers—mailing lists, for example—the speed and efficiency that the 16-bit computers provide make it possible for those lists to be searched through and sorted faster.

(Consider the addition of just one name to a mailing list. When it's added, everything else on the list has to be moved to make room for it, and, possibly—if the program requires it—rearranged. A 16-bit computer will perform a task such as that much more rapidly than an 8-bit one.)

High-resolution computer graphics are more and more in demand, and the only way to generate them efficiently and quickly is through the use of computers using longer word-lengths and able to access more memory more rapidly.

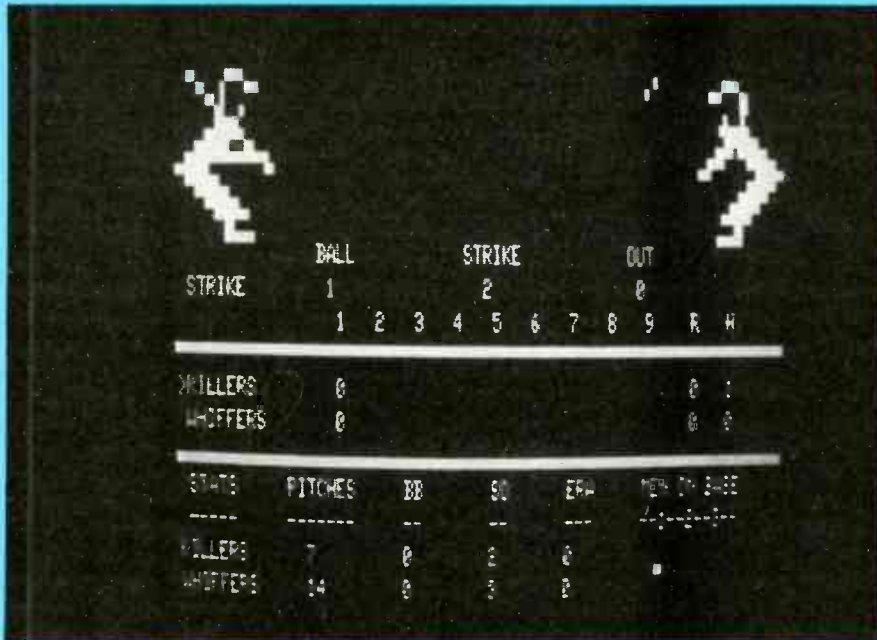
If your applications call for tasks where heavy number-crunching (including that which has to be performed in simulations—graphic and otherwise), complex data manipulation, or a very high degree of accuracy are required, a 16-bit computer could well be worth the investment. If, on the other hand, you will be using your computer for less complicated jobs, or if a few more seconds are not a critical factor for you, then a good old, tried-and-true, 8-bitter is probably what you should be looking for. As long as your computer can keep up with your demands, there's no real need to look for a bigger one. R-E

Games and Leisure Time



Once you've balanced your company's budget, completed your design project, and checked the late stock-market prices, it's time to give your computer—and yourself—a break.

HERB FRIEDMAN



WILLIAM F. BUCKLEY, JR., THE SYNDICATED COLUMNIST, PUBLISHER, and TV personality, recently complained in his newspaper column that he had never read a good reason for owning a personal computer for the home—other than for playing games.

Actually, games *are* an important part of personal computing. While I seriously doubt whether anyone ever spent several thousand dollars on a full-blown personal computer system just to play games, the ability to play games is inherent in all personal computers—so why not play them? There is nothing wrong with blasting a few Klingons after a three-hour stint building a *VisiCalc* or *SuperCalc* model of your company's financial situation for the next thousand years. And there's no reason why the programmer working on a computer design for a perpetual-motion widget can't relax with a challenging game of computer chess, or by zapping another hundred Klingons.

The truth is that personal-computer games are so popular that several manufacturers offer plug-in ROM (Read Only Memory) game cartridges for their more-or-less-conventional computers; that way, the engineer can switch from designing a missile defense-system to zapping space invaders with the flick of the wrist, and without waiting minutes or even just seconds for the game to load from tape or disk.

Some game history

The very first computer game I came across was supplied with my Radio Shack *TRS-80 Model I* computer. It was a blackjack game written in BASIC, and typical of BASIC programs, it was s-l-o-w. The program was supplied on a cassette tape along with a computer version of backgammon. It took almost a minute to load, assuming the level from the recorder was correct: actually, it often took two or three tries to get a perfect load.

The program would deal a hand by having the CRT screen s-l-o-w-l-y trace each card's rectangular outline on the screen, and then identify the card within the rectangle as "8 CLUBS," "KING HEARTS," and so on. Watching the computer play blackjack was a new and exciting experience—the first hundred times. Then the novelty wore off; after the initial thrill of getting the computer to "do something useful" I would get restless waiting for the display to create the cards—but that was a fault of BASIC, the language used to write the program. Graphics produced by interpreted BASIC's are slow, and there's no way

to get around the problem. (Compiled BASIC's are a lot faster, but that's an entirely different subject.)

For the first few years of personal-computer history, games weren't much better than blackjack. The "biggies" were endless versions of nim, electronic dice, and a host of other math-based programs you could just as easily write or type in yourself as purchase in prerecorded form. In fact, most of the early game cassettes were nothing more than a collection of simple, math-oriented BASIC programs that high school kids used to run on their school's time-sharing computers.

But things have changed. While simple games written in BASIC are still sold, personal computers have available almost every conceivable type of game, including some rather good simulations of standard arcade games.

There are auto races and galactic wars; baseball, football, basketball, and other sports—and more galactic wars; superb chess and checkers, and still more galactic wars; *Pac Man* and its innumerable imitators, and still *more* galactic wars; endless versions of "Breakout," and maze-type games; and—the latest craze—the adventure games where the player must figure out a means to bypass the dragons, spacemen, soldiers, creatures, pits, poisons, and passions, in order to: a) find the treasure, b) find the girl, c) just plain escape, d) do anything else he can possibly imagine.

A variety of games

There are "intellectual" games where you can plan a new world, "brain-teaser" or "brain-buster" games, and even computer versions of *Monopoly*, including Monopoly-type games of the "Wall Street wheeler-dealer" sort (complete with robbing widows and orphans—just like real life); and of course, the very popular galactic-war games.

While personal-computer versions of arcade games such as *Pac Man* and *Galaxian* are the hottest things going in games, there are high-resolution arcade-type games using color that have been written specifically for personal computers, such as the *Eliminator* game for the *Apple II*. *Eliminator*, which is typical of the latest personal-computer color arcade-type games, uses high-resolution graphics, and its characters and action are as detailed as you're likely to get from the arcade games at your local video-game emporium.

Of course, not all arcade-type games are high resolution. Radio Shack's computers, in particular, simply don't have inherent hi-res (high-resolution) capability, but they get along quite nicely with a little less resolution by creating plenty of exciting graphics. In particular, the *Chess* software for the *Color Computer* uses color for added excitement, and the game itself is rated by knowledgeable players to be superior in both action and presentation to the chess games offered for use with the home

videogame consoles.

While we're on the subject of high-resolution graphics, the new versions of blackjack give you a good idea of what you can expect from current software. A few paragraphs back I referred to the rectangles in "ancient" software that represented playing cards with their values printed within them. Well, the new hi-res versions of blackjack actually duplicate the playing cards you might find in a realtime deck. ("Realtime" is computerese for

TABLE 1—DIRECTORY OF INDEPENDENT GAME SOFTWARE SUPPLIERS

Game software is available from computer manufacturers, and in addition, from many independent suppliers, such as the ones listed below.

AARDVARK SOFTWARE, INC.
783 N. Water Street
Milwaukee, WI 53202

ACCENT SOFTWARE
3750 Wright Blvd.
Palo Alto, CA 94306

ACORN SOFTWARE PRODUCTS
634 N. Carolina Ave. S.E.
Washington, DC 20003

ADVENTURE, INTERNATIONAL
507 East Street
Box 3435
Longwood, FL 32750

ALPHA PRODUCTS
79-04 Jamaica Ave.
Woodhaven, NY 11421

ALPHA QUEUE SYSTEMS
PO Box 20885
Dallas, TX 75220

ALTERNATE WORLD SIMULATIONS
PO Box 941
Milpitas, CA 95035

AMBER SOFTWARE
170 Parsippany Rd.
Parsippany, NY 07054

ARCADE PLUS
5276 Hollister Ave.
Santa Barbara, CA 93111

ARTWORX SOFTWARE CO.
150 N. Main Street
Fairport, NY 14450

ATKIN RESOURCES
1693 Merribee Way
Salt Lake City, UT 84121

AUTOMATED SIMULATIONS
1988 Leghorn
PO Box 4247
Mountain View, CA 94043

AVALON HILL GAME COMPANY
4517 Hartford Rd.
Baltimore, MD 21214

AVANT-GARDE CREATIONS
PO Box 30161
Eugene, OR 97403

BARCLAY BRIDGE, INC.
8 Bush Ave.
Port Chester, NY 10583

BARGAINBYTE
PO Box 23195
Harahan, LA 70183

BASICS AND BEYOND, INC.
Box 10
Amawalk, NY 10501

BERLINERSOFT
102 Jericho Turnpike
New Hyde Park, NY 11040

BIG FIVE SOFTWARE
14619 Victory Blvd. No. 1
Van Nuys, CA 91411

BRODERBUND SOFTWARE
2 Vista Wood Way
San Rafael, CA 94901

BUDGECO
428 Pala Ave.
Piedmont, CA 94611

BULLSEYE SOFTWARE
PO Drawer 7900
Incline Village, NV 89450

BUSINESS AND PLEASURE SOFTWARE
6011 San Felipe
Houston, TX 77057

BYTE-A-BIT COMPUTING CO.
PO Box D
Levittown, NY 11756

CAVALIER COMPUTER
PO Box 2032
Del Mar, CA 92014

CE SOFTWARE
801 73rd St.
Des Moines, IA 50312

THE CODE WORKS
PO Box 550
Goleta, CA 93116

COMPUGAMES
19 Booth Street
Enfield, CT 06082

COMPUTER CONSULTING
6723 E. 66th Place
Tulsa, OK 74133

COMPUTER LEARNING CONNECTION
One Boston Place
Boston, MA 02108

COMPUTERWARE
Box 668
1512 Encinitas Blvd.
Encinitas, CA 92024

COMPUTRONICS
50 N. Pascack Road
Spring Valley, NY 10977

COMTRONIC SYSTEMS
PO Box 3325
Kent, WA 98031

CONTINENTAL ADVENTURES
4975 Brookdale Street
Bloomfield Hills, MI 48013

THE CORNSOFT GROUP
6008 N. Keystone Ave.
Indianapolis, IN 46220

CREATIVE SOFTWARE
201 San Antonio Circle No. 270
Mountain View, CA 94040

CRYSTAL COMPUTER
17120 Monterey Road
Morgan Hill, CA 95037

CYBERTRONICS INTERNATIONAL
999 Mt. Kemble Ave.
Morristown, NJ 07960

DAKINS CORPORATION
PO Box 21187
Denver, CO 80221

DATAMOST
9748 Cozycroft Ave.
Chatsworth, CA 91311

DYNACOMP
1427 Monroe Ave.
Rochester, NY 14618

ECHELON
6513 Lankershim Blvd., No. 2212
N. Hollywood, CA 91606

EDU-WARE SERVICES, INC.
PO Box 22222
Agoura, CA 91301

EL COMP PUBLISHING
53 Redrock Lane
Pomona, CA 91766

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“the world as we know it,” as opposed to “the world as represented by a computer program.”) Within the rectangle on the screen is a reasonable facsimile of actual cards; the queen of diamonds will show the queen along with the diamond suite. The same goes for the king and jack; while the ace of spades would really look like an ace of spades. This enhances the “playability” of the game.

The newer games, written specifically for personal comput-

ers, are often spectacular, with an almost artistic use of color (for color computers). Many are licensed versions of arcade games, and, as such, have a certain air of quality (and a price to match). On the other hand, many of the less expensive older games were originally written for mainframe (giant-size) computers and have been scaled down for personal computers. Many scaled-down games are strictly second-rate by my standards; others might claim that they are prime junk.

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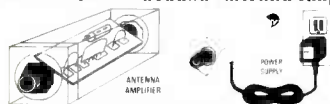
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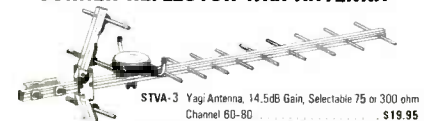
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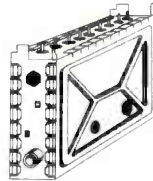
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Software for the Home



Whether it's balancing your checkbook, keeping track of your coupons, or helping your children learn, your computer can be quite a help around the house—if you have the right software. Here's a look at what's available.

HERB FRIEDMAN

BACK IN THE EARLY DAYS OF PERSONAL COMPUTING (A COUPLE of years ago) we frequently heard and read of how the new computers would make our lives easier by lowering our energy costs, keeping burglars out of our homes, insuring perfect records for an IRS audit, and so on. It turned out, though, that there was a larger and more lucrative market for business-oriented software than there was for software for personal use. As a result, somewhere along the line the "home and family" got lost—at least as far as the major software suppliers were concerned. Most of the home-and-family software that was available came from computer hobbyists, and consisted of spruced-up editions of old games and various versions of checkbook-balancing programs.

But while the business-software industry grew, a quiet revolution was taking place in software design specifically for the home and family. Imaginative programmers discovered there was money to be made in software for the home. More important, it was easier to sell far-out ideas for a modest price than to compete head-on with the major software houses.

Today, home-and-family software is no longer another version of some card game, or a checkbook-balancer, or another mailing list, or text editor, or word processor, or a way to convert the navy's recipe for 5000 portions of chipped-beef-on-toast to four family servings. Home-and-family software can now teach office skills, overcome reading disabilities, improve SAT (Scholastic Aptitude Test) scores, provide easy access to information sources, and...well, the best way to illustrate the revolution in home-and-family software is to show some practical examples. Bear in mind the fact that some of the home-and-family software mentioned here may not be available for the particular computer you own; but, as a general rule, similar software is available for all popular personal computers.

Home-and-family software covers a very broad range of applications. Some—perhaps most—is inexpensive, lightweight fluff that will make a routine task more fun, provide an evening's entertainment while it accomplishes a routine task, or uses a new method to do an old chore. For example, there's a program from Cottage Software that simply prints labels for cassettes. If you have a large cassette-library it's a great program. That type of software generally costs little more than pocket change, so don't expect to be overwhelmed when you run it.

Improving reading skills

Other home-and-family software offerings are real heavyweights and are priced accordingly; but they do something important, something you usually can't get done any other way within the normal constraints of your budget, time, or lifestyle. For example, when I went to school a child who couldn't learn to read was considered a "dummy," or worse. Usually, he or she was the butt of a teacher's insensitive remarks. Today, we realize that many children who can't read suffer from the disability known as dyslexia; they don't perceive letters and numerals, or even whole words or phrases, the same way that you and I see them. There were also the slow readers: I was one of them. I simply did not see multiple phrases and/or sentences; I had to read everything two or three times to get an idea of what was being said. (Many years later, as an adult, I took a speed-reading course, and, after a few sessions, was able to read and comprehend at normal speed.)

Today, we have the opportunity to nip that type of reading problem in the bud, at an early age and right in the home, with a program called *SpeedRead+* from Optimized Systems Software, Inc. Presently available for Apple and Atari computers, the program teaches speed reading and comprehension by allowing the user to program the phrasing, speed, and organization of standard text on the computer's screen. As the user's ability improves he or she can reduce the display time (flash rate) of each phrase, group of phrases, or paragraph, restructure the display, or do whatever else is needed to push on to faster reading and better comprehension. The program even comes with "tests."

While the program obviously isn't for everyone, consider that, today, schools have reading specialists who have ways to uncover reading programs at an early age. We no longer call the child with a reading program a "dummy" and sit him or her in a corner. Perhaps convenient, flexible, reading-practice with a computer program in the home has greater value than the few minutes a day the child might spend with a reading specialist in the school. Again, I'm not advocating that specific type of software for everyone with reading difficulties; but I think it's an excellent example of the quality and importance of much of the home-and-family software available today.

Obviously, home-and-family software covers a rather broad range of interests. As a general rule, the type of software we'll

discuss either meets the criteria for reasonable performance from a low-cost computer system, or unusual value (in some areas) for the family, even if a full-blown, business-type system is required.

Personal finance

Let's start out with our old friend the checking-account program. Early versions simply took the place of check stubs: you could balance your monthly or quarterly bank statement, and maybe "pull out" checks of a specific type. Modern checkbook programs, such as *Money Manager* from Acorn Products, keep track of all your expenditures on a monthly basis. They can "split" a check, or payments—for example, allocating \$40.67 of a \$100 check to pay the phone company and the remaining \$59.33 for the supermarket. They can even take into account automatic withdrawals (such as a monthly mortgage payment), provide subtotals in various categories, allow you to extract tax-deductible expenditures, and provide formatted printouts by category and date. While that may sound like a "business" database, it's not; it is intended for home-and-family expenses and is easier to use than a business-oriented program.

Many software houses provide checking-account software similar to Acorn's, but few that are so extensive in coverage and so easy to use. One of the other "easy" home money-managers is Radio Shack's *Budget Management*. It is somewhat different in that it concentrates primarily on providing great detail about exactly how your money was spent. Speaking from personal experience, I was absolutely astounded to discover how seemingly insignificant daily expenses can add up.

Other home-and-family money-manager programs are those such as *Koupon Keeper* from Kensoft, that keep track of the cents-off and refund coupons you get in newspapers and junk mail. The exact functions of those programs vary somewhat but they all work in a similar manner to help you stretch the shopping budget. Daily, weekly, or whenever you have time, you enter the information from the cents-off and refund coupons into the computer: their values, expiration dates, and most important, the types of food or products they're for. Before you go out for the next big family shopping-expedition you enter your shopping list in the computer. The program then compares your coupons against your shopping list and lets you know what coupons are available for specific items or brands. For example, if your list contains the entry "coffee," the computer will tell you which brands you have coupons for, and how much of a discount each offers; you then decide which to use. You can also call for a listing of coupons for a specific brand, or for coupons with a certain expiration date. If you're a dedicated coupon-clipper the software can really help you save!

The cassette label-maker software from Cottage Software that I mentioned earlier isn't a money-saver but it's sure to be valuable for someone. That one prints cassette labels, the kind you stick to both sides of the cassette. It prints on labels supplied on a tractor-feed paper carrier (a strip of paper with holes punched on both sides). If you have an extensive cassette collection you'd like to label in library style, or you're into making recordings and copies for the local rock bands, or reading for the blind, or even distributing your own computer programs, it's a great way to give your cassette tapes the "pro" look, as well as putting a lot of data on the labels automatically. Unfortunately, Cottage supplies only a sample strip of the labels with the software; additional labels are available from them.

Until they start itemizing their possessions, few people have any idea of what they really own, or how much it's worth. A home-and-family program that could help you if you were burglarized is Hayden's *Personal Property Inventory*. It does exactly what its name implies—it keeps a record of each item you own with a description, serial number, and value. While you can keep all that information on paper, it's much easier to update alphabetically or chronologically if it's in the computer.

One modification I'd like to see in "personal inventory" programs is the use of one of the fields to accommodate a "purchase number" for the purchase receipt or sales slip. That



would make it easier to find the actual record when it was needed. Each time an item was entered into the inventory, its sales slip would be given a purchase number. Assume, for example, that your home was robbed and you lost a valuable camera. When you ran the inventory program to find its value, it might also show that the sales receipt was numbered 1364. If you filed the sales slips in order—as you should have—it would be easy to find the original sales slip for the insurance company.

The same applies to repairs. If your TV set broke down and your warranty required you to present the sales slip to get it fixed, it would be easier to locate a numbered sales slip than to search through a stack of them going back several years.

Self improvement

Education is a category in which just about everyone has an entry; unfortunately, much of what there is has little value. You do not really need a computer to teach a four-year-old that if you take two purple boxes from four purple boxes you are left with two purple boxes (but it looks good on a color computer).

When I think of educational software I much prefer to think of materials that will actively assist someone to pursue an interest in a manner, or to a level, not normally available; or of software that will train someone—such as a teenager, a housewife ready to return to the work force, or a college student needing summer employment—for tomorrow's skills.

Today, most entry-level white-collar jobs require touch typing. College students, and others, stand a poor chance of finding the sort of part-time or summer employment that used to be called a "file clerk's" job if they can't type. Computers make fantastic typing teachers. Most typing programs flash a series of letters on the screen which student must match in sequence by typing on the keyboard. The computer keeps track of errors and finger motion, and provides a readout of the student's "effective speed" after the errors are factored in. As the student progresses, the complexity of the exercises can be increased.

In the field of computer-aided instruction, or C.A.I. as it is more commonly called, the sky appears to be the limit on what's offered for home-and-family use. But you must always ask yourself: "Does it really do anything for me?" Or, better still, "Is this C.A.I. program worth anything?" There's a lot of worthless stuff around.

Consider for a moment learning a language by computer. Why bother? In addition to the program, you will need an audio cassette to teach pronunciation. And if there is no such tape, how are you supposed to learn pronunciation from the screen? (And, indeed, there is a program teaching a foreign language—one of the most difficult to learn—that has no accompanying pronunciation tape.)

Then there are programs that will translate a limited foreign-language vocabulary to English. Supposedly, that will teach you to read, if not speak, that language. What a waste of good computer time! There's a 30-dollar handheld device that will do the same thing...for what it's worth.

But don't get me wrong—there is good C.A.I. for the home.

TABLE 1—INDEPENDENT HOME AND FAMILY SOFTWARE SUPPLIERS

Home and family software is available from computer manufacturers, and also from many independent suppliers such as the ones listed below.

ACORN SOFTWARE PRODUCTS INC.

634 N. Carolina Ave. S.E.
Washington, DC 20003

ACTIVITY RESOURCES INC.

PO Box 4875
Hayward, CA 94540

ADDISON-WESLEY PUBLISHING COMPANY

2725 Sand Hill Road
Menlo Park, CA 94025

ADVANCED OPERATING SYSTEMS

450 St. John Road
Michigan City, IN 46360

ADVENTURE INTERNATIONAL

507 East Street
Box 3435
Longwood, FL 32750

APPLE-CATIONS

21650 W. Eleven Mile Road
Suite 103
Southfield, MI 48706

ARTWORX SOFTWARE CO.

150 N. Main Street
Fairport, NY 14450

AVANT-GARDE CREATIONS

PO Box 30161
Eugene, OR 97403

BARGAINBYTE

PO Box 23195
Harahan, LA 70183

BASICS AND BEYOND, INC.

Box 10
Amawalk, NY 10501

BELL AND HOWELL

7100 N. McCormick Road
Chicago, IL 60645

BLUEBIRD'S COMPUTER SOFTWARE

2267 23rd Street
Wyandotte, MI 48192

BRAIN BOX

601 W. 26th Street
New York, NY 10003

BUSINESS AND PLEASURE SOFTWARE

6011 San Felipe
Houston, TX 77057

CALIFORNIA SOFTWARE

PO Box 275
El Cerrito, CA 94530

CLASS 1 SYSTEMS

17909 Maple St.
Lansing, IL 60438

COMM*DATA SYSTEMS

PO Box 325
Milford, MI 48042

COMMSOFT

665 Maybell Ave.
Palo Alto, CA 94306

COMPUMAX, INC.

PO Box 1139
Palo Alto, CA 94301

COMPUTER-ADVANCED IDEAS, INC.

1442A Walnut St.
Suite 341
Berkeley, CA 94709

COMPUTER AIDED & MANAGED INSTRUCTION

PO Box 2030
Goleta, CA 93118

COMPUTER-ED

1 Everett Rd.
Carmel, NY 10512

COMPUTER INFORMATION EXCHANGE

PO Box 159
San Luis Rey, CA 92068

COMPUTER LEARNING CONNECTION

One Boston Place
Boston, MA 02108

COMPUTER SHACK

1691 Bason
Pontiac, MI 48054

THE COMPUTERIZED SHOPPER

3545 El Camino Real
Palo Alto, CA 94306

COMPUTRONICS

50 N. Pascack Rd.
Spring Valley, NY 10977

COOK'S COMPUTER COMPANY

1905 Bailey Dr.
Marshalltown, IA 50158

COTTAGE SOFTWARE

614 N. Harding
Wichita, KS 67208

CREATIVE COMPUTING

39 E. Hanover Ave.
Morris Plains, NJ 07950

CREATIVE SOFTWARE

201 San Antonio Circle #270
Mountain View, CA 94040

CYBERTRONICS INTERNATIONAL

999 Mt. Kemble Ave.
Morristown, NJ 07960

DR. DALEY'S SOFTWARE

Water St.
Darby, MT 59829

DRESEN ASSOCIATES

PO Box 248
Dresen, ME 04342

DYNACOMP

1427 Monroe Ave.
Rochester, NY 14618

EDUCATIONAL ACTIVITIES

1937 Grand Ave.
PO Box 87
Baldwin, NY 11510

EDUCATIONAL MICRO SYSTEMS

PO Box 471
Chester, NJ 07930

EN-JOY COMPUTER PRODUCTS

PO Box 1535
Goleta, CA 93116

ENTELEK

Ward-Whidden House
The Hill
PO Box 1303
Portsmouth, NH 03801.

ETRONIX

14803 NE 40th St.
Redmond, WA 98052

EZ SOFTWARE

PO Box 591
Novato, CA 94947

FUTUREVIEW

PO Box 101
Joplin, MO 64802

GOOTH SOFTWARE

931 S. Bemiston
St. Louis, MO 63105

J.L. HAMMETT COMPANY, INC.

Hammett Pl.
PO Box 545
Braintree, MA 02184

HARTLEY SOFTWARE

PO Box 431
Dimondale, MI 48821

HAYDEN

50 Essex St.
Rochelle Park, NJ 07662

HIGH TECHNOLOGY SOFTWARE PRODUCTS INC.

PO Box 14665
8001 N. Classen Blvd.
Oklahoma City, OK 73113

HOWE SOFTWARE

14 Lexington Rd.
New York, NY 10956

INFORMATION UNLIMITED SOFTWARE

281 Arlington Ave.
Berkeley, CA 94707

INSTANT SOFTWARE

Peterborough, NH 03458

INTELLIGENT INVESTOR

810 Camelview Plaza
6900 E. Camelback Rd.
Scottsdale, AZ 85251

**INTERNATIONAL SOFTWARE
MARKETING, LTD.**

120 E. Washington St.
Syracuse, NY 13202

INTERPRETIVE EDUCATION

2306 Winters Dr.
Kalamazoo, MI 49002

INVESTOR SOFTWARE

48 Iron Ship Plaza
San Francisco, CA 94111

J & S SOFTWARE

140 Reid Ave.
Port Washington, NY 11050

KATE'S KOMPUTERS

PO Box 1675
Sausalito, CA 94965

KENSOFI

2102 50th St.
Kenosha, WI 53140

KRELL SOFTWARE

21 Millbrook Dr.
Stony Brook, NY 11790

LEARNING TOOLS INC.

4 Washburn Pl.
Brookline, MA 02146

LEVEL IV PRODUCTS INC.

32461 School Craft
Livonia, MI 48150

THE LIBERTY SOFTWARE CO.

635 Independence Ave. SE
Washington, DC 20003

LIGHTNING SOFTWARE

PO Box 11725
Palo Alto, Ca 94306

LITTLE GENIUS

34-38rd St.
Jackson Heights, NY

L & S COMPUTERWARE

1589 Fraser Dr.
Sunnyvale, CA 94087

MACROTRONICS, INC.

1125 N. Golden State Blvd.
Suite G
Turlock, CA 95380

MANHATTAN SOFTWARE

PO Box 1063
Woodland Hills, CA 91365

MASTERWORKS SOFTWARE INC.

1823 W. Lomita Blvd.
Lomita, CA 90717

MED SYSTEMS SOFTWARE

PO Box 2674
Chapel Hill, NC 27514

MENTOR SOFTWARE

Box 791
Anoka, MN 55303

MERCER SYSTEMS INC.

87 Scooter Lane
Hicksville, NY 11801

MERRY BEE COMMUNICATIONS

815 Crest Dr.
Omaha, NE 68046

META SOFTWARE ENGINEERING

4737 Trumbull SE
Albuquerque, NM 87108

MICROGNOME

5843 Montgomery Rd.
Elkridge, MD 21227

MICROLAB

2310 Skokie Valley Rd.
Highland Park, IL 60035

MICRO LEARNINGWARE

PO Box 2134
N. Mankato, MN 56001

MICROMATIC PROGRAMMING CO.

PO Box 158
Georgetown, CT 06829

MICRO POWER & LIGHT CO.

12820 Hillcrest Rd., No. 224
Dallas, TX 75230

MONUMENT COMPUTER SERVICE

Village Data Center
PO Box 603
Joshua Tree, CA 92252

MUSE SOFTWARE

347 N. Charles St.
Baltimore, MD 21201

**NATIONAL SOFTWARE MARKET-
ING**

4701 Mckinley St.
Hollywood, FL 33021

OCO, INC.

1001 J. Bridgeway, Suite 128
Sausalito, CA 94965

OPTIMIZED SYSTEMS SOFTWARE

10379 Lansdale Ave.
Cupertino, CA 95014

OPTIONS-80

PO Box 471
Concord, MA 01742

OSBORNE/McGRAW-HILL

630 Bancroft Way
Berkeley, CA 94710

PCD SYSTEMS

PO Box 143
Pen Yan, NY 14527

PEAR SYSTEMS CORP.

27 Briar Brae Rd.
Stamford, CT 06903

POWERSOFT CORP.

PO Box 157
Pitman, NJ 08071

PRACTICAL PROGRAMS

1104 Aspen Dr.
Toms River, NJ 78377

PRENTICE HALL

Sylvan Ave.
Englewood Cliffs, NJ 07632

PRESCRIPTION LEARNING

1301 S. Wabash Ave.
Chicago, IL 60605

PROGRAM DESIGN, INC. (PDI)

11 Idar Court
Greenwich, CT 06830

THE PROGRAMMER'S INSTITUTE

PO Box 3191
Chapel Hill, NC 27514

PROGRAMS FOR LEARNING

PO Box 954
New Milford, CT 06776

**PROGRAM RESEARCH AND SOFT-
WARE CORP.**

257 Central Park West
New York, NY 10024

QUALITY EDUCATION DESIGN

PO Box 12486
Portland, OR 97212

QUALITY SOFTWARE

6660 Reseda Blvd. No. 105
Reseda, CA 92335

RELL

1145 Stanford Ave.
Redondo Beach, CA 90278

**RESOURCE SOFTWARE IN-
TERNATIONAL**

140 Sylvan Ave.
Englewood Cliffs, NJ 07632

RIGHT ON PROGRAMS

PO Box 977
Huntington, NY 11743

SCOTT, FORESMAN & CO.

1900 East Lake Ave.
Glenview, IL 60025

SERENDIPITY SYSTEMS INC.

225 Elmira Rd.
Ithaca, NY 14850

SILWA ENTERPRISES, INC.

PO Box 400
Big Flats, NY 14814

SOFTBYTE COMPUTING

Box 217
Wallingford, CT 06492

THE SOFTWARE CONNECTION

10703 Meadowhill Rd.
Silver Spring, MD 20901

THE SOFTWARE EXCHANGE

6 South St.
Milford, NH 03055

SOFTWARE HOUSE INC.

695 East 10th North
Logan, UT 84321

SOFTWARE RESOURCES, INC.

286 Alewife Brook Pkwy.
Suite 310
Cambridge, MA 02138

SOLARTEK

PO Box 298
Guiderland, NY 12048

SOUTHFORK SOFTWARE

68 Fairlake Dr.
Hattiesburg, MS 39401

SOUTHWEST EDPSYCHE SERVICES

PO Box 1870
Phoenix, AZ 85001

SPECTRUM SOFTWARE

142 Carlow
Sunnyvale, CA 94087

STANDARD AND POORS CORP.

25 Broadway
New York, NY 10004

STEKETEE EDUCATIONAL SOFTWARE

4639 Spruce St.
Philadelphia, PA 19139

STERLING SWIFT PUBLISHING CO.

1600 Fortview Rd.
Austin, TX 78704

STORYBOOKS OF THE FUTURE

527 41st Ave.
San Francisco, CA 94121

TARA

PO Box 118
Selden, NY 11784

TERRAPIN, INC.

678 Massachusetts Ave.
Cambridge, MA 02139

T.H.E.S.I.S.

PO Box 147
Garden City, MI 48135

3 R SOFTWARE

PO Box 3115
Jamaica, NY 11431

TIME SHARE CORP.

Hanover, NH 03755

TYC SOFTWARE

40 Stuyvesant Manor
Geneseo, NY 14454

TYCOM ASSOCIATES

63 Velma Ave.
Pittsfield, MA 01201

MAX ULE AND CO., INC.

6 E. 43rd St.
New York, NY 10017

UNICOM

297 Elmwood Ave.
Providence, RI 02907

VERSA COMPUTING, INC.

3541 Old Conejo Rd. Suite 104
Newbury Park, Ca 91320

WE SOFTWARE

800 Greenwich Dr.
Chico, CA 95926

WINDOW INC.

469 Pleasant St.
Watertown, MA 02172

XPS INC.

323 York Rd.
Carlisle, PA 17013

For example, Atari has a lovely reading-comprehension program for youngsters ages 8 and up, and nicely structured basic and advanced vocabulary builders. If you have a youngster with some reading and vocabulary problems in school a good, fun-filled, home-and-family program can be a decided asset. It works because the computer is doing what it does best—patiently repeating itself, over and over, without becoming bored or tired. (Others besides Atari offer reading and vocabulary builders, but some are better than others. Take a look at the software before you buy; make sure it's suitable for your child.)

As for unusual education, consider a map of the heavens. There are probably ten programs that print a map of the U.S. and ask the child to indicate the state capitals. But what about the budding astronomer in your family? For him or her, high adventure might be a trip to the local planetarium; but imagine a planetarium—actually a map of the heavens—on your home computer! The *Star Search Astronomy Guide* from Softbyte Computing will display a map of the overhead skies for north and south of the equator, with double stars, galactic and planetary nebula, open and globular clusters, and the external galaxies all shown to scale according to their polar coordinates for any 24-hour period of any day in the year. The screen also displays a lot of information such as the Messier number (if assigned), magnitude, right ascension, etc. It's pure gold to an amateur astronomer, and it costs only \$20 for the cassette version.

Speaking of gold, one of the hot commercial databases is the one supplied by Dow Jones for the professionals who wheel and deal in stocks and bonds. The problem for the amateur dabbler in the market is that the professional databases aren't cheap. There's lots of home-and-family software around, though, specifically intended for those who think they can outperform the professional money-managers. There's software that lets you create bar charts of trading prices on a daily, weekly, monthly or yearly basis, create comparison charts, and construct any model that you think will outperform the Dow Jones averages. If you have the time to fuss with those programs—meaning loading them with data—you probably could play the market with some reasonable degree of computer-aided expertise.

For those who don't want to develop new ways to gamble in the stock market, but who own stocks and bonds, there are several programs—at least one for every model computer—that simply keep track of your investments, income, sales, etc.

Recreational programs

Getting away from the serious end of personal computing for the home and family, do you know who your ancestors are, how

they interrelate, and where you and yours stand in the order of things? Well, a program such as *Your Family Tree* from Acorn Software traces your ancestry, shows who is related to whom, and might even show that you are ninety-sixth in line to the English throne. Naturally, the more data you can locate and feed into the program, the more detailed the results will be. While the family tree might not be your cup of tea, there are many good people who get a lot of pleasure out of discovering who married whom—and who didn't.

And when you finally assemble the living members of the family tree and get them together for a family blow-out, how will you fare when you serve the libations—otherwise known as drinks? Are you the type who serves whiskey sours in a wine glass? Do your pina colodas look more like brandy alexanders? If you want to make like a pro bartender at the family feast, but can't tell a cocktail glass from a wine decanter, there's a program especially for you called *Bartender*, from En-Joy Computer Products that lists 84 different drinks. It tells you the recipe and gives a graphic display of the correct glass to serve it in. You can either run through the entire list alphabetically to learn the craft, or call up a specific drink. It sure makes for great conversation to have your computer on the bar and let the guests watch you prepare drinks according to its instructions.

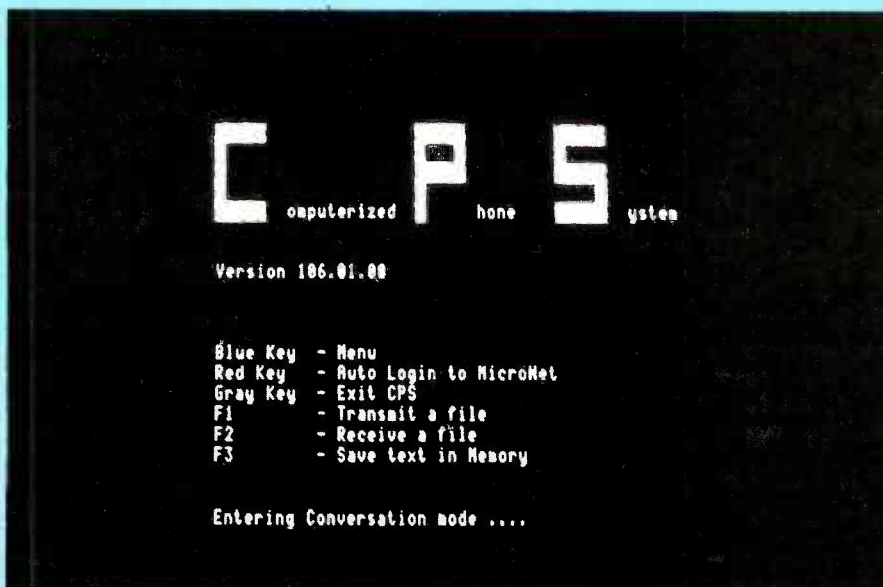
Got a yen to make like the folks who created the computer graphics in *TRON*? *Sketch-80* from quality Software will let you draw figures on the computer screen, move them around, enlarge and shrink them. In short, you enter the world of computer art. Who knows; the next call from Hollywood might be for you.

Are you a coach in Little League or Midget football, or do you help run the PAL (*Police Athletic League*) basketball program? Your local computer shop will probably have a goodly assortment of computer scoring-systems that will determine each player's performance for various skills for each game, or cumulatively for all games played. It's a heck of a way to run a kids' team, but if you're one of those coaches out to win at any cost, there's a team-performance program just made for you.

As you can see, there's home-and-family software for just about any application, and at just about every intellectual level. We've only looked at the tip of the iceberg to give you an idea of the large subject-range available for personal computers.

While not every program we've mentioned is available for every personal computer, as we stated way back at the beginning, there is similar software for the most popular models. Write to the companies mentioned here and in Table 1, read the ads, and—of course—check with your local computer store to see what they have or can get for you.

R-E



Hook your computer into a vast network of resources and information. All you need is a modem, software, and a telephone

HERB FRIEDMAN

IN THE EARLY DAYS OF COMPUTING THERE WAS NO SUCH THING as a personal computer. There were mainframe computers and minicomputers, which were sort of scaled-down mainframes. Users generally accessed the computers through terminals that consisted of essentially two devices in a common cabinet: a keyboard that sent signals entered by the user to the computer, and a display that displayed the information the computer sent back to the user. Depending on the particular terminal, the display generated either a "hard copy," meaning it was printed on paper, or a "soft copy," meaning it was displayed on a CRT screen.

If the terminal was located close to the computer, it was usually directly connected through wires. If the terminal was remote from the computer, it was normally connected through some form of telephone circuit—either a dedicated high-speed line, or the slower (usually 110 to 300 baud) voice-grade dial-up telephone system.

Naturally, if one can feed information in and out of a computer through a terminal, it's almost as easy to have computers talk to each other, passing data back and forth even when no one is around. Any of the mainframe computers can be instructed to automatically dial-up or interconnect with another computer to swap data.

The terminal system was adequate for many, many years, particularly for "time-sharing" systems. In time-sharing, the computer automatically samples the input from many terminals, all feeding in at the same time. It samples information in the correct order, maintains the input/output from each terminal independently, and automatically holds up input from the terminals if necessary; in effect, time-sharing makes it appear as if each terminal user is the only one using the computer. Another feature of time sharing systems is that they usually provide access to several programming languages, data storage and processing, and special services. The system works well, except for the fact that the printers and all other peripherals are usually located at the computer, miles away from the terminal.

Now, thanks to the personal computer, all of that has changed. The user can have everything at his or her fingertips: tape or disk storage, printers, card readers, and the like. He or she also can use many programming languages, including extended MicroSoft BASIC, a powerful high-level language.

Even somewhat decent versions of Fortran, Cobol, and Pascal are available for personal computers.

Personal computers do have one major limitation, however: They can not access the major databases, or software written for other machines, very easily. For example, if your friend on the other side of town has written exactly the software you need to run your bowling league, but his version is written for a Commodore or Atari computer and you have an Apple, there's no way you can run his software directly, even if he gives you a copy of his disk or tape.

Then again, there are many people writing good software they are willing to share at little or no charge if you can access their computer through a CBB (Community Bulletin Board). That, in its most basic form, is simply a personal computer that can be accessed by anyone by simply placing a telephone call. There are also commercial databases, such as The Source and CompuServe Information Service, which provide various services, including stock data, newspaper and magazine articles, forums for computer user groups—the list is almost endless. All of that, and more, can be accessed directly by a personal computer, if the computer could be made to "think" that it is a terminal. That is easy enough to do because there is software for that purpose available for virtually any personal computer. Some can even be obtained from CBB's or user groups, again at little or no cost; we'll look at the commercially available terminal programs later in this article.

Before we confuse the subject, let's take time out to explain the difference between a terminal and something called a "host." A host is simply the computer that is accessed by a terminal or another computer. In our example of the early mainframe computer and time-sharing systems, the computer was the host.

There was no problem here because it was the only host. But personal computers are something else. Load one with one type of software and it serves as a terminal. Use other software and it serves as a host to which other terminals or computers can be connected. For example, assume you have created a database of all the articles in **Radio-Electronics** for the past 20 years. Your buddy on the other side of town wants to locate an article on the invention of the transistor. If he programs his Commodore computer to function as a terminal, and you have programmed

your computer to serve as a host (sometimes it doesn't even need a special program), he can dial your phone. your computer will answer and download the data from your **Radio-Electronics** database—your computer serves as the host. Got the picture? If not, read it again because it's important if you're to understand the rest of this article.

When computers talk to each other or to terminals, that is called telecommunications, and all that is ever meant when someone refers to "personal computer telecommunications" is that a personal computer is being used to exchange data or software with another computer or terminal.

Modems

Two things make personal computer telecommunications possible: the *modem* and the software. The term modem is an acronym derived from *MO*dulator/*DE*Modulator. It's a device that converts the electrical signals of a computer to audio signals that can be transmitted over the telephone line.

For personal computers, modems are usually Bell-103 compatible, meaning they're compatible with the type-103 modem used to transmit data at up to 300 baud over the voice-grade telephone system. (For commercial use, especially when the computers are mainframes, there are modems that can transmit at 9600 baud, but those require the use of a special dedicated telephone hook-up.)

Modem technology was originally developed for use with mainframe computers and the technical terms used to describe modem operation are left over from those days. Since the access to the computer originated at the terminal, the modem used at the terminal was called an originate modem, transmitting to the computer on 1270 and 1070 Hz and receiving from the computer on 2225 and 2025 Hz. Since the computer answered the terminal, the modem used at the computer—or host—end of the circuit was called an answer modem; it transmits on 2225 and 2025 Hz and receives on 1270 and 1070 Hz, the exact reverse of the answer modem. For many years the only modem commonly available to users of personal computers were originate-only, because "home" computers only served as terminals. With few exceptions, there was very little thought given to providing a way for personal computers to "converse" with other personal computers.

But the modern user of personal computers finds there is often a need for his computer to converse with another, such as when swapping software or data. The way that is done is to provide one terminal with an answer modem; it doesn't matter which computer has the answer modem as long as the telecommunications circuit consists of one answer and at least one originate modem. Because of the considerable interest that is developing in telecommunications between personal computers, many low-cost modems are now available with switch-selected or automatic originate and answer operating modes. The user with the double-function switch-selected modem flips the selector to the opposite of that being used by the other computer. If it is an automatic modem, it senses the frequencies of the received tones and automatically shifts to the required operating mode (originate or answer).

There are several types of modems available for personal computers, with new ones seemingly appearing every month or so. The most basic models are the manually switched originate and originate/answer modems. Personal-computer modems have an RS-232 input/output. (Commercial modems can also include a 20 mA current drive, or TTL, or whatever; but modems for personal computer use always have, at the very least, an RS-232 I/O.)

If the computer doesn't have an RS-232 interface it must be added to the computer. For example, the RS-232 interface is optional on the Radio Shack *TRS-80 Model I* and *Model III* computers. Commodore computers require a special interface to convert their IEEE-488 I/O to RS-232. In addition, there are two very popular non-RS-232 modems. One is from the Micropower Corp.; it connects directly to the *TRS-80 Model I* keyboard, eliminating the expense of the expansion and RS-232

TABLE 1—UNITERM COMMAND LISTING

- A - ACTIVATE AUTO BUFFER OPEN/CLOSE FEATURE
- B - LOAD AND SAVE BINARY FILES
- C - CLOSE BUFFER
- D - DISPLAY OR PRINT BUFFER
- E - EXIT TO DOS
- H - SELECT HALF OR FULL DUPLEX
- I - DEFINE INITIALIZATION PARAMETERS
- L - LOAD ASCII FILE TO BUFFER
- M - CHANGE MODEM PARAMETERS
- O - OPEN AND ZERO BUFFER
- P - TRANSMIT BUFFER IN PROMPT FORM
- R - TRANSMIT BUFFER WITH AUTO OPEN/CLOSE BUFFER CODES
- S - SAVE BUFFER IN ASCII FORMAT
- T - TRANSMIT BUFFER (NORMAL)
- W - SET SCREEN WIDTH
- X - TYPE TO BUFFER

interfaces. Another variation is the D.C. Hayes *Micromodem II* modem for the Apple computer. It plugs directly into one of the slots in the Apple computer and does not require an RS-232 I/O.

There are modems that automatically dial a telephone number from a disk directory, or from the computer keyboard, and models that automatically answer the telephone and connect the computer when a "carrier" tone from another is received. But all that is a subject for another time, so let's move along to using the modems for telecommunications, and the special software necessary.

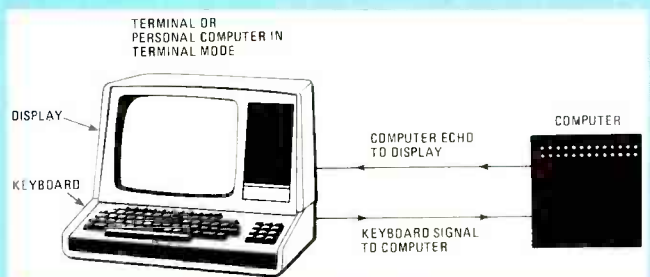


FIG. 1—IN FULL DUPLEX operation, the keyboard sends a character to the computer and the computer "echoes" the character back to the display.

The standard modem circuit used for terminals, and personal computers functioning as terminals, is "full duplex", meaning that the terminal functions as a separate keyboard and display, as shown in Figure 1. The keyboard transmits a character to the computer. The computer echoes the character back to the display, confirming that the transmission is correct. If the character displayed doesn't match what was sent to the computer, the user knows that he has big problems somewhere in the circuit. The echo is usually instantaneous, and it is often assumed by newcomers to personal computing that the display shows what the keyboard is sending. Not true. It shows what the computer assumes it has received; it's confirmation from the computer.

Some modems can also operate in what is called half-duplex, which has two operating modes. Generally, the display shows what is sent by the keyboard and then the echo from the computer. For example, the transmission HELP would appear in half-duplex as HHEELLPP. Some so-called half-duplex modems actually cancel the echo, displaying only the keyboard entry. HELP would appear as HELP; it looks correct but it is not a computer confirmation. While that system has its applications, it is not particularly good for use with personal computers.

Terminal software

None of the popular personal computers can operate directly as a terminal. At the very least they require some "terminal" software, if not some special hardware in addition to the modem itself. Selecting the appropriate terminal software is important.

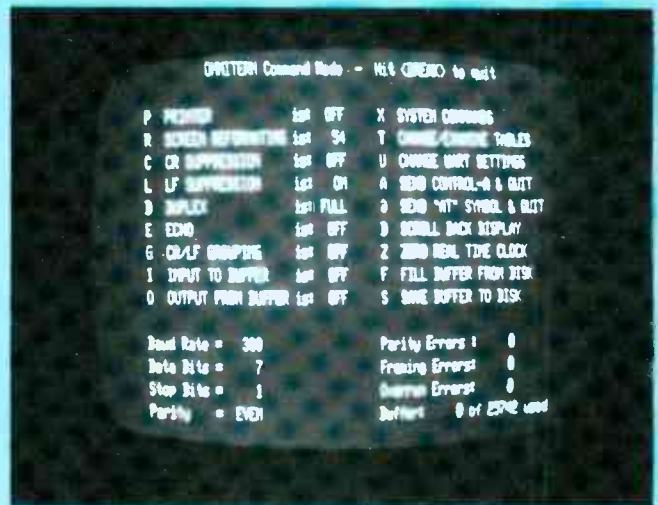
as it is the software that determines how much flexibility you can get from your personal computer.

The terminal software is of two varieties: dumb and smart. A dumb terminal is the functional equivalent of the basic terminal consisting of the keyboard and the display. Your computer might have four disk drives, and many-thousand bytes of memory, but if it functions as a dumb terminal all you can use is the keyboard and the display. Smart terminals, depending on the particular software, can use the disk and tape storage systems as well as all memory and external peripherals. They also can exchange software with other computers, and some even automatically convert the peculiarities of one computer system for another. For example, most personal-computer terminals output data in ASCII, but mainframes often use EBCDIC (Extended Binary Coded Decimal Interchange Code). If your personal computer is "talking" to a mainframe, the proper software will convert the incoming EBCDIC code to ASCII, and the outgoing ASCII to EBCDIC. Or, it can automatically correct for whatever the user wants, substituting different characters for standard codes.

The exact terminal features provided by your personal computer will depend on the type of terminal software you purchase, and its price. As a general rule, the more you pay the more you get. For example, the original terminal software for the TRS-80 was very basic, providing the standard full duplex configuration but leaving a few non-standard codes in place of standard ASCII characters. On the other hand, The Microperipheral Corporation's basic TRS-80 software, which is supplied with their modems for the TRS-80 computer, provides the special ASCII symbols required by some time-sharing services that are not inherent in the TRS-80; and the software provides a notable "extra" feature—a screen print feature that allows whatever is displayed on the screen to be printed (provided, of course, that you have a printer).

To use all the capabilities of your personal computer for telecommunications you need smart terminal software, and here the sky's the limit as to functions and price. On the surface it seems that every software writer has his own idea of what is important and desirable. Some inexpensive smart software provides the most commonly desired features, has but a few commands, and is extremely easy to use. Other smart terminal programs are loaded with every conceivable feature, and are so difficult to use that the casual user must often make frequent references to the documentation in order to perform what should be an insignificant procedure.

How smart you want your computer to be, and the number of desired functions, will determine the complexity of the particular software you need. For example, a universal terminal program



OMNITERM, from Lindbergh Systems, is a smart-terminal program that displays the command list on your computer's screen.

from BT Enterprises called *Uniterm* can automatically configure itself for one of four possible computer/modem combinations. It can accommodate a variety of printers, be configured in different "permanent" versions for various host computers, and accommodate different screen widths. It can also upload or download software in both ASCII and binary, transmit automatic sign-on-messages, and—well, the list is seemingly endless, because *Uniterm* was intended to accommodate almost every possible desired or necessary smart-terminal procedure. It can even skip over the perforations on continuous-form paper (tractor feed or web-mounted single sheets) used with friction feed printers.

Documentation is notably good (not excellent—very little software documentation can be accurately described as excellent), going into specific details on using several popular brands of modems. One of the really nice features is that the screen will display the command list, as shown in Table 1, which the user can access directly.

Another smart-terminal program that displays the command list on the screen is *Omniterm* from Lindbergh Systems. It has many similar features and functions as *Uniterm*. A major difference is that *Omniterm* is very heavy into special character configurations (conversions). It can be reconfigured to receive and transmit virtually any deviation from standard ASCII, even the complete code if necessary.

A much more basic smart-terminal program, also much less

TABLE 2—DIRECTORY OF INDEPENDENT MODEM MANUFACTURERS

In addition to computer manufacturers, modems are available from many independent manufacturers, such as the ones listed below.

APF ELECTRONICS, INC.

1501 Broadway
New York, NY 10036

BIZCOMP

Box 7498
Menlo Park, CA 94025

HAYES MICROCOMPUTER PRODUCTS

5385 Peachtree Corners East
Norcross, GA 30092

LEXICON CORPORATION OF MIAMI

1541 NW 65th Avenue
Plantation, FL 33313

LIVERMORE DATA SYSTEMS

2050 151st Place NE
Redmond, WA 98952

THE MICROPERIPHERAL CORP.

2643 151st Place NE
Redmond, WA 98052

MULTI-TECH SYSTEMS, INC.

82 Second Avenue SE
New Brighton, MN 55112

NOVATION

18664 Oxnard St.
Tarzana, CA 91356

OMNITECH DATA

2405 South 20th St.
Phoenix, AZ 85034

QUEST ELECTRONICS

P.O. Box 4430E
Santa Clara, CA 95054

RACAL-VADIC INC.

222 Caspian Drive
Sunnyvale, CA 94086

TNW CORP.

3351 Hancock St.
San Diego, CA 92110

US ROBOTICS

203 N. Wabash, Suite 718
Chicago, IL 60601

UNIVERSAL DATA SYSTEMS

5000 Bradford Drive
Huntsville, AL 35805

TABLE 3—INDEPENDENT TERMINAL SOFTWARE SUPPLIERS

In addition to computer manufacturers, terminal software is available from many independent suppliers, such as the ones listed below.

ACE COMPUTER PRODUCTS OF FLORIDA

1640 NW 3rd Street
Deerfield Beach, FL 33441

APPARAT, INC.

4401 S. Tamarac Parkway
Denver, CO 80237

B.T. ENTERPRISES

171 Hawkins Road
Centereach, NY 11720

CAWTHON SCIENTIFIC GROUP

24224 Michigan Ave.
Dearborn, MI 48124

DYNACOMP, INC.

1427 Monroe Ave.
Rochester, NY 14618

EIGEN SYSTEMS

PO Box 10234
Austin, TX 78766

INSTANT SOFTWARE

Peterborough, NH 03458

MICROCOM

1400A Providence Highway
Norwood, MA 02062

MICROSTUF, INC.

1900 Leland Dr.
Suite 12
Marietta, GA 30067

MUMFORD MICRO SYSTEMS

Box 400-E
Summerland, CA 93067

NELSON SOFTWARE SYSTEMS

PO Box 19096
Minneapolis, MN 55419

SMALL BUSINESS SYSTEMS GROUP

6 Carlisle Road
Westford, MA 08166

SOUTHWESTERN DATA SYSTEMS

PO Box 582
Santee, CA 92071

VISICORP

2895 Zanker Road
San Jose, CA 95134

expensive, is *Telcom* from Mumford Micro Systems—a nice program to use between two personal computers because it has programmable echo, will exchange both ASCII and binary data, and is fuss-free. It also has a very simple printer control that prints both the incoming and outgoing characters. It has an associated spooler that will store up to 256 characters if the printer should be slower than the information input to it. Unlike the super-smart terminal programs that can redefine virtually every code, *Telcom* provides up to ten special characters and can store eight custom messages. There is no on-screen command display, but the documentation supplied with the program is good.

A somewhat unusual smart-terminal program for personal computers is the Heath/Zenith *CPS* (Computerized Phone System) for their H8 and H89/Z89 computers. *CPS* is configured specifically for use with CompuServe and other Heath/Zenith computers, and it uses the special-function keys found on the H89/Z89 computer. It will automatically log the user on to CompuServe at the touch of a single function key (though many other smart terminals can be programmed to do the same thing). It has the automatic protocols for transmitting files (from disk) through CompuServe's Micronet, or another Heath/Zenith computer (or it will operate with no protocols), and it has most of the other smart-terminal features such as a resettable clock and echo (when serving as a host or for computer-to-computer communication).

One very nice feature is that text can be saved in memory. Everything coming in can be saved in memory automatically, as it appears on the screen, or just selected portions can be saved by turning the buffer on and off from the terminal's keypad without entering the command mode. A count of available bytes in the buffer is continuously displayed. Finally, the memory can be dumped to disk under a specific file name, to be printed or edited at a future time. It's all very similar to what's available with other smart-terminal software, but what sets this software apart is that it is considerably more convenient to use; that is mainly because the operating functions of the terminal's special-function keys are always displayed in reverse video on the bottom line.

One notable difference between *CPS* and other smart-terminal software is that *CPS* can handle data files only in ASCII form; the presently available version does not accommodate the transfer of binary files.

Virtually all other terminal software for personal computing is similar to those that we have already covered. It is logical to

assume, however, that many personal computers will also be used for business applications, and the casual user in the home might want or require access to the Western Union Telex II (TWX) network. For them, there is software such as *TXL Telex Link* from the Cawthon Scientific Group. *TXL* allows the personal computer to function as an intelligent telex station, replacing the conventional paper-tape telex machine. With a paper-tape telex machine, the outgoing message is first punched on a paper tape, which allows correction of typing errors. When the tape is "perfect", it is passed through a paper-tape reader that transmits the message from the tape. With the *TXL* software, the user prepares the message using a text editor; then *TXL* automatically formats the text for telex and transmits the file. Incoming telex messages are received and displayed, the date and time is added to them, and they are then written to disk storage. Essentially, *TXL* is smart-terminal software tailored for a specific kind of telecommunications.

From one computer to another

Finally, let's close with an unusual application of smart-terminal software. I have several different personal computers at the office. Often, I find that software I have written in BASIC for one computer might be better running on another system, or a department with a different computer asks for a copy. What I do in that instance is to load one computer with elementary smart-terminal software.

The other computer is loaded with smart-terminal software that permits extensive reconfiguring of the ASCII codes, and it is reconfigured for the first computer. For example, when feeding *TRS-80* BASIC programs to a *Heath H89*. The RS-232 I/Os of the computers are connected together with the send and receive connections at one computer reversed. Press the buttons and the program goes hassle-free from one system to another. About the only remaining problems would be to clean up a few syntax errors caused by the different versions of BASIC so that the program runs correctly.

That is exactly the same procedure you would use to exchange programs between different computers via a telephone link; the only major difference is that I have substituted a direct-wire connection for the modem-based telecommunications circuit. Obviously, a link between different computers must be done in ASCII; for personal computers, binary files can be transmitted only between the same type of computers, using smart-terminal software that specifically allows binary upload and download of the memory.

R-E



The large databases offer a vast array of information and services, but just how useful or necessary are they for the personal computer user?

Dial-up Software Networks

HERB FRIEDMAN

THE WORLD AT YOUR COMMAND! TOMMOROW'S NEWS TODAY! Weather reports from around the world! Advice by experts on everything—from what's new in electronics and photography to advice to the lovelorn! Stock market information that will make you an instant millionaire—assuming you started with \$2 million (that's a stock trader's joke)! More information than was stored in the legendary great library at Alexandria.

And where is this fountain of information? It is in the databases of The Source (1616 Anderson Road, McLean, VA 22102) and the CompuServe Information Service (5000 Arlington Centre Blvd., Columbus, OH 43220)—at least that's what's implied by the claims made by both.

From humble beginnings

CompuServe, which is owned by H & R Block (the tax people), and The Source, now owned by Reader's Digest, both started out primarily as a way for computer hobbyists with "home" computers to obtain mainframe computer services at moderate cost. This included better programming languages (such as advanced version of BASIC, APL, FORTRAN, and now Pascal), text editors, disk storage, and even printouts of their work. (Remember, that was back in the days when a disk system for personal computers was extremely rare, and printers cost almost as much as the computer.) Both provided electronic mail delivery between their subscribers, a national bulletin board for users, and electronic versions of CB radio that members could use for "on air" (or is it "on computer?") meetings of user groups (The CompuServe Apple user group is one of the most famous).

The original concept behind all of that was to sell the computer hobbyist—the forerunner of the personal computerist—mainframe computer time and data services at a very attractive rate during time periods the computers normally weren't used—the off-peak periods. The idea was to make the off-peak rate so low that the typical hobbyist would be inclined to use The Source or CompuServe, thereby producing revenue from the

computers during those hours. But the personal computer explosion—or revolution, depending how it appears to you—almost instantly eliminated the appeal of programming on those services; as a result, their primary use now is as an "information database," providing access to many varied information services.

Both The Source and CompuServe offer many similar information services; even their operating prices are similar after the initial membership fee. CompuServe is sold (at the time this article was prepared) as part of Radio Shack's videotex package for \$29.95 or \$19.95, depending on whether you use a computer as a smart terminal or are using a dumb terminal. Standard service is billed at \$5.00 per hour of connect time between 6 pm and 5 am local time. Prime time service from 8 am to 6 pm is \$22.50 an hour. CompuServe assigns a local phone number for you to use. If they don't have one in your area you must connect through Tymnet; the surcharge for that is \$2.00 per hour in the contiguous 48 states. CompuServe membership includes 128K of disk storage, with additional memory available for a small charge. But, the storage must be accessed monthly; you can run up charges just to keep the disk storage active. Many services are free, though there are surcharges for stock market quotes, a computer buying service, billing details, etc. The monthly charges can be billed to Visa, MasterCard, or directly billed for an extra \$3.00 per statement surcharge.

Membership in The Source, available through local computer stores, costs \$100.00. Connect time charges are \$5.75 per hour during the evening, weekdays and a few holidays, and \$4.25 per hour midnight to 7 am daily. Prime time (7 am to 6 pm) charges are \$18.00 per hour. The special features that would usually require selective surcharges (as with CompuServe), such as stock quotes, legislative reports, and the like, are rolled into a basic package called SOURCE*PLUS; that package has flat per hour connect time fees of \$15.00, \$10.00, and \$40.00, corresponding to the basic service hours. The user can purchase disk storage at prices ranging from \$.50 to \$.05 per 2K of memory.

depending on the total order. (20K and more is \$.05-per-2K). There are, however, some additional small monthly charges for account maintenance and for each connect. The Source assigns a local access telephone number, usually through the Telenet or Tymnet systems, whose cost is included in the basic fees; there is no extra charge.

Is it for you?

Both The Source and CompuServe are jam-packed with database services. Virtually anything you can imagine is available. If you just can't wait to see the news headlines you can get them through your computer: The Source has UPI, CompuServe has AP. You can even read the syndicated features: The Source will tell you this Tuesday what columnist Jack Anderson will say next week. Need stock market information? Both will give it to you. Want to read what's new in anything? *Popular Science* has an information service on CompuServe. Looking for financial aid for a college student? Both services claim to provide the information. The list of information that's available is almost endless. Much of it comes from the information services of other sources, such as the *New York Times* and other newspapers. Value Line (for the stock market's outlook), Dittler Bros., Inc. (for flight information), and so on. (There is generally a surcharge for financial and legislative reports.) Both services feature an electronic shopping service called Comp-U-Star, which sells goods at discount prices through the personal computer. The cost is charged to your credit card. That also has a surcharge in the form of a membership fee.

Another popular feature of those services is that you can play

```

>INFO BLACKJACK
                BLACKJACK
-----
DESCRIPTION
-----
You are at odds with a computer dealer in a game of Blackjack. Both you
and the dealer try to get the number sum on your cards as close to 21 as
possible without going over (Busting). You will automatically lose if
you bust. Make a wager for each hand if you want. The honest dealer will
keep a running tally of your winnings.

INSTRUCTIONS
-----
To Execute: PLAY BLACKJACK

The computer will start each hand by printing 'WAGER:'. Type the amount
you wish to bet on the next hand. If you want to stop the game type
'0' for your wager, or depress the 'BREAK' key at any time.

Remember, in the game of Blackjack all face cards count as 10, and
Aces can be worth 1 or 11 points as desired.

All of your responses should be numbers. In a yes/no-type question
a response of '1' signifies yes and a '0' signifies no.

SAMPLE OUTPUT
-----
>PLAY BLACKJACK

WAGER: 5
I SHOW          3 OF HEARTS
FIRST CARD IS   2 OF HEARTS
NEXT CARD IS    7 OF DIAMONDS
HIT? YES
INPUT data error
HIT? 1
NEXT CARD IS    3 OF SPADES
HIT? 1
NEXT CARD IS    JACK OF DIAMONDS
YOU BUSTED, YOUR TOTAL IS 22
MY HOLE CARD IS  9 OF SPADES
YOU'RE BEHIND $ 5

WAGER: 5
I SHOW          7 OF CLUBS
FIRST CARD IS   QUEEN OF CLUBS
NEXT CARD IS    ACE OF SPADES
**BLACKJACK**
MY HOLE CARD WAS JACK OF HEARTS
YOU'RE AHEAD $ 2.5

WAGER: 10
I SHOW          4 OF DIAMONDS
FIRST CARD IS   7 OF SPADES
NEXT CARD IS    2 OF CLUBS
HIT? 1
NEXT CARD IS    2 OF SPADES
HIT? 1
NEXT CARD IS    3 OF CLUBS
HIT? 1
NEXT CARD IS    JACK OF SPADES
YOU BUSTED, YOUR TOTAL IS 24
MY HOLE CARD IS KING OF HEARTS
YOU'RE BEHIND $ 7.5

```

A SAMPLE RUN of Blackjack, one of the many casino-style games available on The Source.

```

>DATA GAMESP
*** GAMES LIBRARY - NO PRINTER REQUIRED ***

ADVENTURE-EXPLORE COLOSSAL CAVE (SUPER GAME!!!) ...PLAY ADVENTURE
BACKGAMMON .....PLAY BACKGAMMON
CASINO STYLE 21 .....PLAY BLACKJACK
CIVIL WAR SIMULATION AGAINST THE COMPUTER .....PLAY CIVILWAR
CHECK CHECKERS CHALLENGE .....DATA CHECK
COIN FLIPPING .....PLAY COIN
SHOOT CRAPS .....PLAY CRAPS
STATISTICS CONCERNING A PARTICULAR DATE .....PLAY DATES
TIC TAC TOE IN SPANISH .....PLAY ESTIC
GET THE FARMER, FOX, CHICKEN, AND GRAIN ACROSS .....PLAY FARMER
MONDAY NIGHT FOOTBALL .....PLAY FOOTBALL
GOLF FOR ONE OR MORE PLAYERS .....PLAY GOLF
GUESS THE COMPUTER'S NUMBER .....PLAY GUESS
HANGMAN WORD GAME .....PLAY HANGMAN
GOVERN ANCIENT SUMERIA .....PLAY HANGMANT
HORSE RACE GAME .....PLAY HORSE
IQ GAME OF SKILL .....PLAY IQTEST
GOVERN THE ISLAND OF SETATS DETIUN .....PLAY KING
LARGE GAME OF GOLF .....PLAY LGOLF
LIFE (COLONY GENERATION) .....PLAY LIFE

LUNAR LANDING SIMULATION .....PLAY LUNAR
COMPANIES COMPETE TO SELL A PRODUCT .....PLAY MARKET
MASTERMIND .....PLAY MIND
ANCIENT GAME OF NIM .....PLAY NIM
ANOTHER NIM .....PLAY NIMZ
CARE TO TRY YOUR LUCK ON THE SLOT MACHINE? .....PLAY ONEARM
PICA-CENTRE (NUMBER GUESSING GAME) .....PLAY PICA
A NEW ADVENTURE GAME .....PLAY PITS
RANDOM POETRY .....PLAY POETRY
POKER AGAINST THE COMPUTER .....PLAY POKER
SCORE FOUR AGAINST THE COMPUTER .....PLAY SCOREFOUR
RANDOM SHAKESPERIAN SONNETS .....PLAY SONNET
FILL IN THE MISSING LETTERS .....PLAY SPELL
STAR TREK (SUPER VERSION!!!) .....PLAY STAR
PLAY THE STOCK MARKET .....PLAY STOCKS
RULE ANCIENT SUMERIA (A DIFFERENT ONE) .....PLAY SUMER
TARGET PRACTICE AS WEAPONS OFFICER ON THE ENTERPRISE .....PLAY TARGET
TIC TAC TOE .....PLAY TICTACTOE
A REGULAR CASINO OF GAMES FROM LAS VEGAS .....PLAY VEGAS
ROULET FOR UP TO SEVEN PEOPLE .....PLAY WHEEL
PATROL THE CITY STREETS .....PLAY WATCHMAN
HUNT THE WUMPU .....PLAY WUMPU

NOTE:
FOR INFORMATION ON ANY GAME TYPE .....INFO (GAMENAME)
I.E., INFO ADVENTURE; TO VIEW A DEMONSTRATION OF CERTAIN
OF THE MORE COMPLEX GAMES, TYPE DEMO (GAMENAME).

```

GAMES OF EVERY DESCRIPTION are among the many services available on The Source and CompuServe. This listing is from The Source.

games, or chat through the CB-type simulators. You can have an entire lifetime of entertainment through The Source and CompuServe.

Now is all of that information and are all of those services worthwhile for the non-commercial user? We gave both a work-out using the services that we thought might appeal to the average home user of a personal computer: someone without a business expense account to refund the charges incurred.

First off, getting anything is slow. Except for special localities and a substantial surcharge for 1200 baud service, both services run at a top speed of 300 baud. That might sound fast if you're trying to follow it on your screen, but it is deadly slow. Both systems come up on an initial menu that directs the user to a particular area. In both systems the user can access a specific subject through a sub-menu—usually a chain of sub-menus (I have gone as high as five). The user also can move directly to the desired page from the main menu if he is familiar with the direct access codes: those are provided by both services, although it is done a lot more clearly by The Source. I'm certain there is someone out there who remembers every page of both services and can punch up anything in seconds, but there are so many codes and so many different access menus, that everything is extra slow if you don't use the services frequently.

Also, the systems are wordy. Almost everything is spelled out in great detail, and CompuServe goes in for a lot of double spacing and scroll pauses when the screen fills. It's little bits and pieces of time but it adds up to big dollars when spread out over thousands of users: it is also frustrating. Accessing Comp-U-Star to see what bargains might be available used up 18 minutes of connect time, and that's a lot of time and access charge to see what's on "special sale."

And when we finally did get to the computerized buying service, it left something to be desired. For example, we were offered a well-known camera with a "standard" lens, unspecified electronic flash, gadget bag, and an unknown wide angle lens. The lens could be the polished bottom of a milkbottle for all we know, as no other information is provided. A similar offer was made for a Nikon EM camera: The standard package

plus an unknown electronic flash for almost \$200. The prices might be terrific for the equipment offered, but precisely what equipment is being sold? A list of sewing machines featured some remarkably good prices. But, I have had many years of experience with sewing machines that don't work when unpacked. Do you suddenly become a shipper if the thing doesn't work right?

Moving along, I looked for some financial aid for a college student. Not one meaningful word on loans or scholarships. Instead, a long printout of the general statements provided by every high school to students and their parents, the same material provided by every college to prospective students, and extensive detail on some special government co-op program that after 15 minutes of connect time still hadn't said what the program was or which schools or agencies were making the offer. It was endless fluff, which is one of the major problems with much of the "free" information. Most of it chews up connect time without providing anything of substance. There are long introductions and special items of news. Even attempting direct access usually puts the user in a menu that flows into another menu.

Since much fanfare had accompanied *Popular Science* joining the CompuServe database I figured I'd give that a try. What could be better than reading a review of personal computer software. In most publications the term "review" means someone actually tried something. If it's equipment they really turned the power on. If it's a computer program I assume someone ran it. But what did I get for my money? Fluff—there was no user report or opinions, just short descriptions that read like they came straight from the manufacturer's brochure. The same stuff I read in the advertisements in the computer magazines.

Surely there must be something of value for the personal

```

>
>DUPI N 6 BAREAN
ENTER STARTING & ENDING DATE - OR PRESS RETURN FOR TODAY

PICK A STARTING STORY NUMBER - FROM 1 (THE EARLIEST)
TO 13 (THE LATEST).
13

READ FORWARD IN TIME (RF), READ BACKWARD (RB),
SCAN FORWARD (SF) OR SCAN BACKWARD (SB)?
SF

13 07-03 03:00 ned=
(9 graf lead, pickup 4th graf: the trip xxx _ carter attacks reagan tax
cut)

PICK A STARTING STORY NUMBER - FROM 1 (THE EARLIEST)
TO 13 (THE LATEST).
13

READ FORWARD IN TIME (RF), READ BACKWARD (RB),
SCAN FORWARD (SF) OR SCAN BACKWARD (SB)?
RB

13 07-03 03:00 ned=
(9 graf lead, pickup 4th graf: the trip xxx _ carter attacks reagan tax
cut)
urgent
previous washington
Carter attacks Reagan tax proposal
By HELEN THOMAS
UPI White House Reporter
LOS ANGELES (UPI) - President Carter today attacked Ronald Reagan's
tax cut proposal as irresponsible, inflationary and impossible to carry
out without cutting federal social services.
For his first public comment on the tax-reduction proposal made by
his probable Republican opponent for the presidency in November, the
president flew to the former California governor's home state.
He told a meeting of the National Education Association, which has
strongly supported Carter's campaign, that Reagan's supposed $6
billion tax cut is "a classic free lunch - something for nothing.
That kind of hasty offer can only be called by one word -
irresponsible," the president said.
"It is sheer deception to promise the American people that we can
have this enormously expensive and unfair tax cut - that we can
dramatically increase defense spending - and still maintain social
programs," he said.
Carter did not mention Reagan by name but press secretary Jody
Powell made it clear the president was directing his remarks at Reagan
and other GOP tax-cut proponents.
Powell also told reporters Carter has not made up his own mind
about a tax cut, but has agreed to work with House and Senate Democrats,
who want to pass their own - lesser - tax cut to rival the Republican
proposal.
Carter was met at the airport by California Gov. Edmund Brown Jr.,
a former rival for the Democratic presidential nomination. Brown praised
Carter's cooperation with California officials and said there is no
hostility between the two men.
Brown has not endorsed Carter. Asked whether he would, Brown
replied: "Not this morning ... It's not the appropriate forum for
that."
The trip, which will be partly paid for by the Carter-Mon
WE ARE ON STORY 13
TYPE "B" "R" "S" OR "D" AND A STORY NUMBER
QUIT

```

GET UP-TO-THE-MINUTE news stories from the wire services on either database. UPI is available on The Source; AP on CompuServe.



computer user. How about The Source's airline schedules? I was about to visit my family in Rochester and a schedule would help. The schedule included everything I wanted to know about all the flights leaving New York for Rochester, except three things: which flights had the special discount fare (there most always is one); what were the requirements for the discount, and which flights had open seats. I had a beautiful print of the schedule and no important information. A three minute call directly to the 800 number of the airline gave me all the information I needed free (except for the price of the toll-free phone call), and in a lot less time than it took the computer. Maybe a businessman who flies First Class on an expense account might be interested solely in what time the plane leaves, but as a family user I'm more interested in the important things, like what's the cheapest way to fly, and do my children get a discount. That information just wasn't in the computer.

About this time my son came home from school, announced he was going on vacation and would buy a used car when he got to his destination. What an opportunity to test computerized classified ads. Since he was headed for Washington, DC, I checked the classified ads in the *Washington Post*. Now that worked just great. There I was in New York checking out used cars in Washington, DC—a perfect use for a computerized information service. I punched in the type of car my son wanted, how much he had to spend, the equipment he wanted, and we got a print of cars for him to inquire about when he got to Washington. The system worked flawlessly and with virtually no fluff; it went right into the classified ads with a minimum of unusually clear instructions—someone did a superb job with this database. It was certainly worth the \$1.00 or so in computer time.

Flushed with success I figured I'd try the database on how to purchase a used car. It was full of the usual platitudes we've heard for years: "Have an expert check the car." "It's someone else's problem," and junk like that. It was on such a low level I kept expecting a recommendation to kick the tires. One would figure that if it's worthwhile putting the information on a computer there'd be something new and substantial—but no such luck.

Another area that proved valuable when doing some research was the New York Times Consumer Database (NYTCD), which consists of abstracts from the *New York Times* and sixty other publications. It's undoubtedly valuable for business people wanting to do some research on a subject, but it's also great for students or anyone else needing generalized information. It's possible to pick up a story or subject and then trace it backwards or forwards to see how it developed. That is another no-fluff database that gets right into the meat of things.

Quite possibly, the NYTCD is a precursor of what to expect if the *Encyclopedia Britannica* or the *World Book Encyclopedia* ever gets on The Source or CompuServe. If that should happen, it will be a fantastic breakthrough for young schoolchildren. Many will have access to a personal computer, which in turn would give them access to most of the information they'll need for school through a computerized encyclopedia and a database

such as the NYTCD.

Deciding to try something different. I looked into a demonstration of electronic banking. It was rather interesting! Aside from the fact there was apparently no hard copy of any payments—my records being only what was entered on my disk storage—I wondered how many people would get access to my entire financial and personal life through electronic banking. In this day and age it appears nothing is sacrosanct, and many organizations exist for the sole purpose of selling all the personal information they can get their hands on; my state even sells the names and addresses of everyone that holds a driver's license. I just wonder how long it would take before all that computerized banking information—information on everything I purchased, every doctor I visited, every lawyer I paid, every debt I owed—was sold to the highest bidder?

Computing services

While both The Source and CompuServe are presently concentrating on information, they do offer something else—mainframe computer services for personal computer owners. Both permit the subscriber to create files of the type used in mainframe data processing. For example, on The Source you can activate a file automatically each time you sign on. The files can be "mailed" to other subscribers, and the electronic mail service will even inform you when you sign on that you have mail waiting. Your files can be personal or public—that is, you can permit anyone to peek at them.

Of course, if you can create files you must have some way to edit them, and an editor is provided. It has more or less standard advanced editing features such as "global change," section moves, tabulation, sorting, and automatic spelling checking.

The services also offer a super timeshare BASIC, FORTRAN, and Pascal. If you're into FORTRAN and Pascal, you most likely will end up with more powerful versions than you

can purchase at reasonable cost for your personal computer. The Source also provides INFOX, a business database manager that can generate special forms. INFOX has its own manuals and those can be purchased, if you wish. Essentially, both The Source and CompuServe provide a lot of computing power. If you're into self-development in the programming area (remember, we're not covering business here) you probably can't get a better dollar value than from The Source and CompuServe. But don't expect to get off cheap. FORTRAN and Pascal are very time consuming when you're first learning.

I am certain that everyone can find something of value on The Source or CompuServe. In the area of computer services it's everyone for themselves, only you know how much computer power you need or could use. In the area of information, however, I feel the most valuable data of any kind was from the professionals who have spent years accumulating and dispensing information in a highly competitive market—newspapers, stock/commodity news services, and the wire services.

For the first few months it's a lot of fun trying out the varied information services of The Source and CompuServe, not to mention the assortment of games, but if you have no specific or frequent need for "hard information," it's questionable whether a permanent commitment or the monthly expense is justified for "just fooling around."

Obviously, there are many personal computerists who find The Source and/or CompuServe an important part of their lifestyle—especially if they are into user groups of any kind. And certainly, for business applications the databases can be important tools, but we are talking about personal computing, and that means primarily home and family. Before putting any money on the line, a logical question to ask is "After the initial fun and excitement, do I have any real need for or interest in any of the services offered? It's a question everyone must answer for themselves."

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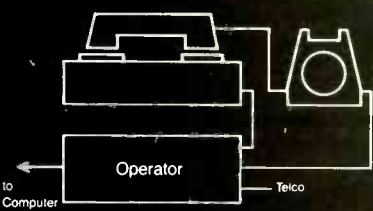
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Part 3 THE FIRST TWO PARTS of this article discussed the theory of operation of the main board of the Picture Phone. We'll now describe the telephone adaptor board and power supply. We'll also begin to look at the construction of the device. As always, it will be helpful to have the previous parts of this article as we proceed.

Telephone adaptor board

The telephone adaptor board, shown in Fig. 8, serves two purposes: it serves as an interface between the main board and the telephone line, and also allows the user to switch between VOICE and PICTURE modes.

Transformer T601 provides impedance matching between the main board and the telephone line's 600-ohm requirements. It also provides electrical isolation between the phone line and the Picture Phone. The transformer contains a grounded electrostatic shield (indicated by the dashed line) to reduce hum. Additional protection to the phone line is provided by a static-discharge device, DT1.

It must be noted that, while those precautions should provide sufficient protection to satisfy your telephone company's requirements for connecting non-company equipment to its lines, the Picture Phone must be used with a coupling device approved by the phone company.

The Picture Phone is connected to the phone line by a standard four-conductor phone cable terminated in a modular phone plug. A modular jack on the rear of the Picture Phone cabinet accepts the plug from an ordinary telephone. The telephone can be used normally when the Picture Phone is off or when it is in the VOICE mode. Connections between the modular jack and the adaptor board are made through an 8-terminal barrier strip, TB601.

The second function of the telephone adaptor board is to provide switching between VOICE and PICTURE modes. Two relays, RY601 and RY602 provide that function. They are controlled by pushbut-

tons S2 and S3 on the front panel. When turned on, the Picture Phone "comes up" in the VOICE mode and the telephone can be used normally. When the PICTURE switch is depressed, though, several things happen.

First, the telephone is disconnected from the line. Usually, that would cause the phone company's equipment to "think" that you had hung up, and dis-

Power supply

The Picture Phone requires five working voltages: plus-and-minus five volts DC, plus-and-minus 12 volts DC, and -20 volts DC. The power-supply schematic is shown in Fig. 9. While a single transformer with two secondaries can be used to obtain all those voltages, it may be difficult to locate; such a transformer is available from the supplier indicated in the Parts List (see last month's issue).

You may, however, choose to use two transformers. Both should be center-tapped. The first should be capable of supplying about 12.6 volts on each side of the center tap, for a total of about 25 volts at one amp. The second transformer should be capable of supplying about 6.3 volts on either side of the center tap, for a total of 12.6 volts at 1.5 amps.

Standard bridge-rectifier/capacitor circuits are used, along with tab-type regulators to obtain the final working voltages. The -20 volts is taken from the input to the -12-volt regulator. A 0.6-amp circuit breaker, CB1, is used for protection.

The output of the +5-volt supply is used to drive LED1, the POWER indicator mounted on the front panel.

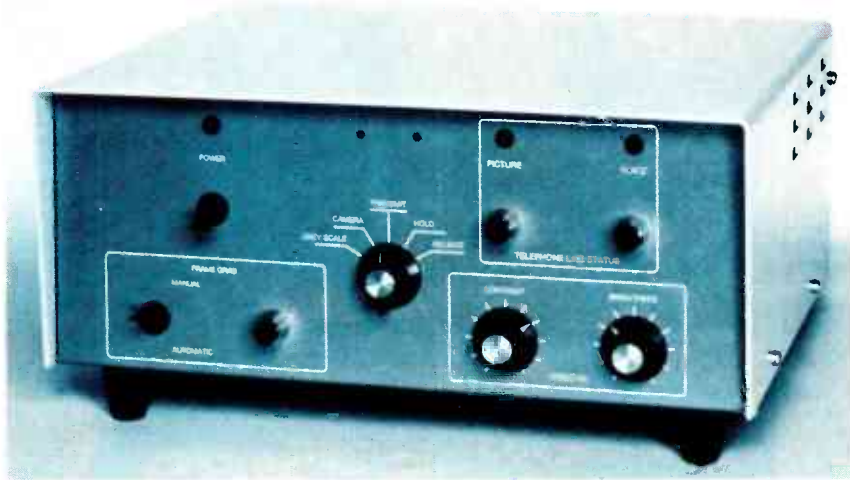
Front-panel controls

The functions of some of the front-panel controls have already been explained; this is what the others do:

Snatch button (unlabelled), S4, is used when you wish to "grab" a frame of video to be transmitted. It is active only when S5, the MANUAL/AUTOMATIC switch is in the MANUAL position. When S5 is in the AUTOMATIC position, a new frame will be snatched automatically every eight seconds.

The BRIGHTNESS and CONTRAST controls, R307 and R305, control the quality of the image that you are transmitting. (There will be more about them in the section on using the Picture Phone.) It is assumed that the party with whom you are exchanging video is sending a good quality picture, so no external controls are

Picture Phone



The telephone adaptor board, the power supply, and construction of the device are the topics covered in this month's look at the Picture Phone.

JOSEF BERNARD,
TECHNICAL EDITOR

connect you. The Picture Phone, however, through relay R601, provides a "holding voltage" which, as far as the phone-company equipment is concerned, means that the phone is still off the hook, and the connection is maintained.

With the telephone out of the circuit, audio is routed to and from the main board of the Picture Phone in the form of a slow-scan video signal, composed of tones ranging from 1500 Hz to 2300 Hz (see Part 1). The mode switch, S1, in the center of the front panel determines whether the slow-scan audio will be transmitted or received.

When the PICTURE switch is pushed, the relays latch, and the Picture Phone remains in the PICTURE mode until the VOICE button is pushed.

Associated with those two switches are LED2 and LED3, which indicate the current status of the device.

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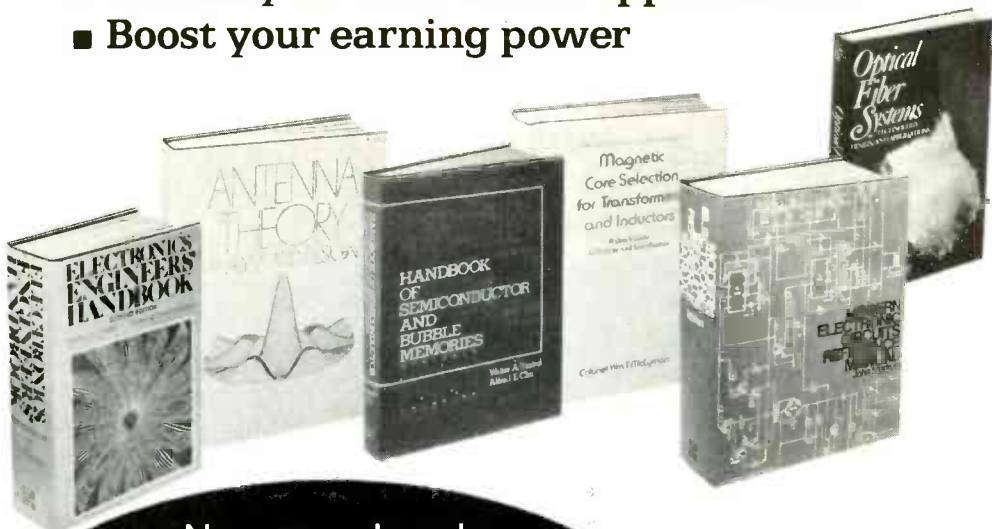
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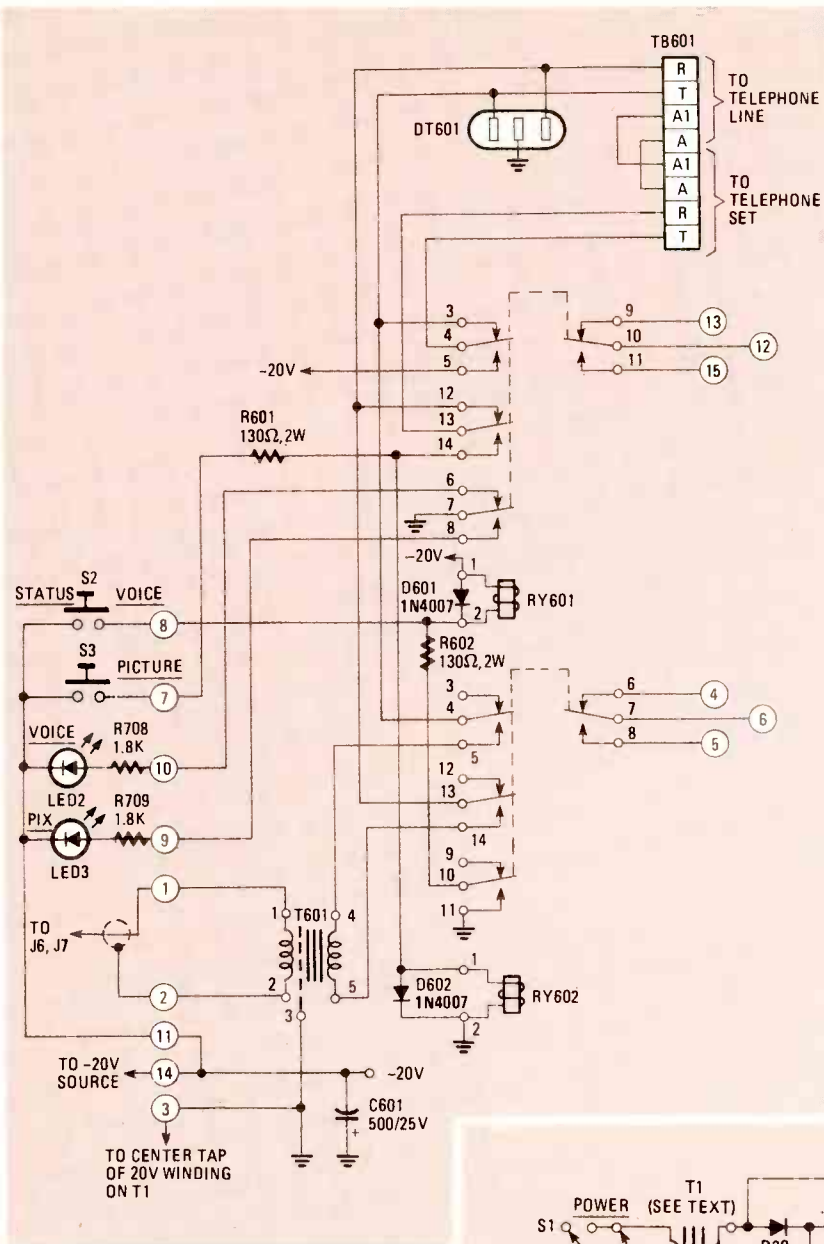


FIG. 8—TELEPHONE ADAPTOR BOARD provides switching and impedance-matching functions, and also controls status indicators.

provided for RECEIVE adjustments.

The final control that needs explaining is the five-position mode switch, S1. In its fully-counterclockwise position, GRAY SCALE, it loads a four-level gray scale into memory for calibration purposes. The next position, CAMERA, allows you to view a real-time digitized image from your camera on your monitor. That permits both focusing and composition, as well as allowing you to set the BRIGHTNESS and CONTRAST controls for best results.

The TRANSMIT position is used when you are in the PICTURE mode to transmit the video stored in the Picture Phone's memory. The next position, HOLD freezes a frame of received or transmitted video in memory and displays it indefinitely, regardless of whether new video is available or not. It is particularly useful if you

want to be able to look at a received image while discussing it in the VOICE mode.

Finally, the function of the RECEIVE position should be obvious—it loads video into the Picture Phone's memory for display on your monitor.

There is one connector on the rear of the cabinet that should be explained. That is a 25-pin DB25-S socket of the type used on computer equipment. It can be used for the connection of remote switches for SNATCH, VOICE/PICTURE, etc.

Construction

Construction of the Picture Phone can be divided into two parts—the three boards (main, phone adaptor, and power supply)—and chassis wiring. It's probably best to complete the first two boards first, and then combine the power-supply board and chassis wiring.

Because of the large size and complexity of the double-sided main board (almost 10 × 12 inches) it is impractical to reproduce foil patterns for it here with clarity. If you want to try to make your own board (it's available from the supplier indicated in the Parts List), full-sized printed (not film) positives can be obtained by sending \$1.50—along with a note indicating that you want the foil patterns for the board and the address to which they are to be sent—to: Picture Phone, Radio-Electronics, 200 Park Avenue South, New York, NY 10003.

The parts-placement diagram for the main board is shown in Fig. 10; refer also to Fig. 11. Assembly of the board is straightforward, and should present little difficulty as long as you proceed with care. Don't rush the job, for that is sure to

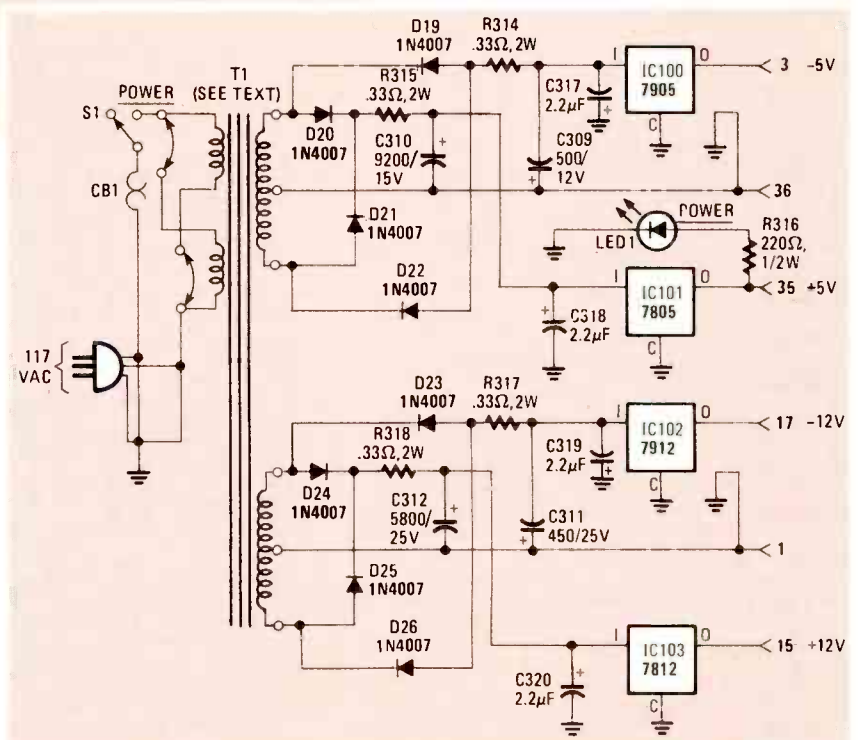


FIG. 9—POWER SUPPLY provides ±12 volts, ±5 volts, and -20 volts. See text and Parts List (in last month's issue) for T1 information.

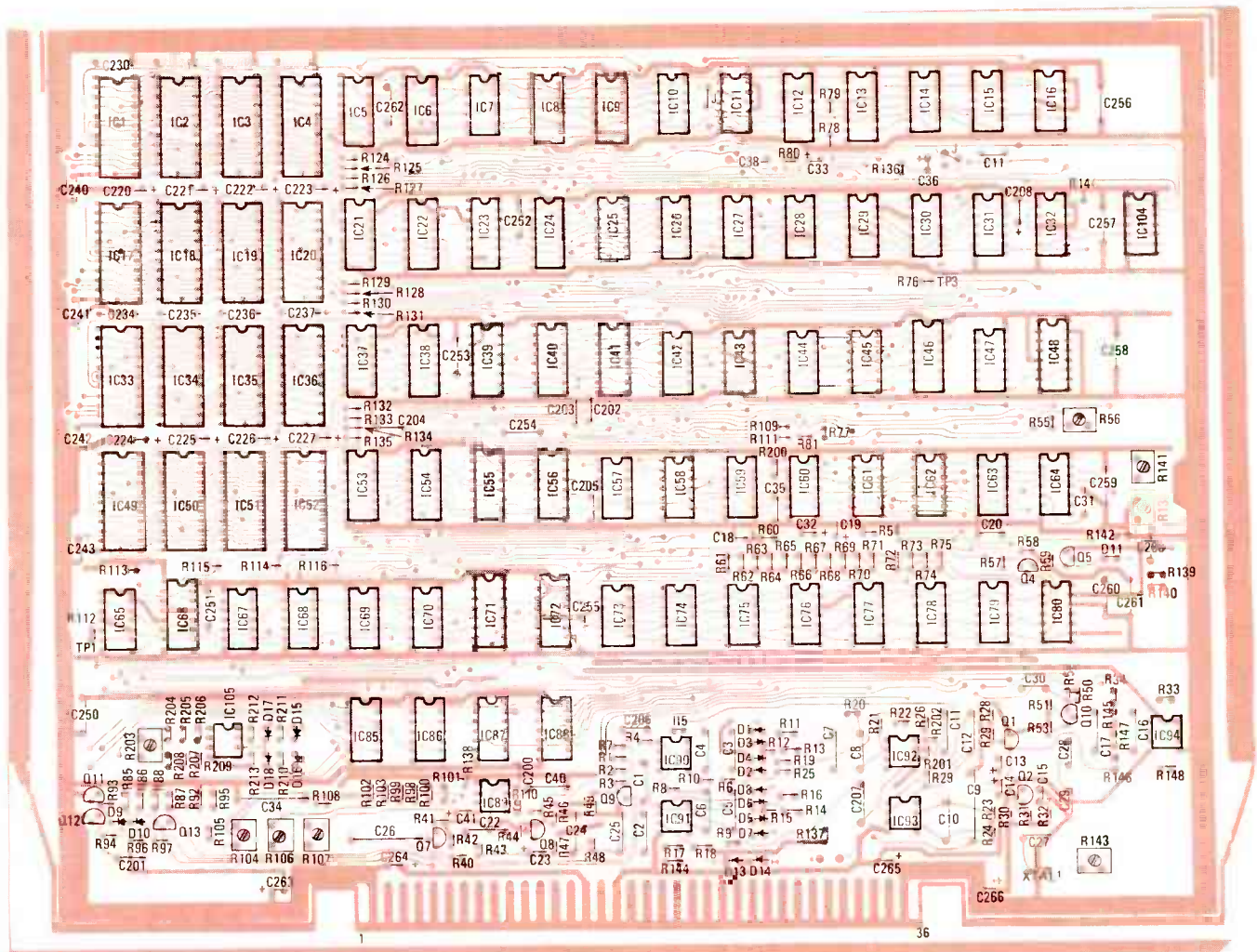


FIG. 10—ALL IC's face in the same direction. Note that resistors and diodes are mounted vertically to conserve board space.

lead to problems, and it will be a long time before you solve them and have your Picture Phone operating.

It's best to insert all the IC sockets first (note that they all face in the same direction) and make sure that you *don't* insert 14-pin sockets where there should be 16-pin ones. Be sure that *all* the pins are soldered—with that many connections, it's easy to miss one, and you'll spend hours or days before you discover that one unsoldered socket-pin is the reason that the equipment isn't functioning.

Next install the resistors and diodes. Note that they are all mounted vertically (standing on end). Be extremely careful about the polarity of the diodes, and don't forget the two short jumpers. Finally, install the capacitors, again being careful to observe the polarities of the tantalum types. **Do not insert any IC's into their sockets yet.** When you're finished with the main board, set it aside temporarily and go on to the phone adaptor board.

That double-sided board, whose foil patterns are shown in Figs. 12 and 13, and parts-placement diagram in Fig. 14, is easy compared to the main board. The parts should slip right into the holes—just make sure that the electrolytic capacitor.

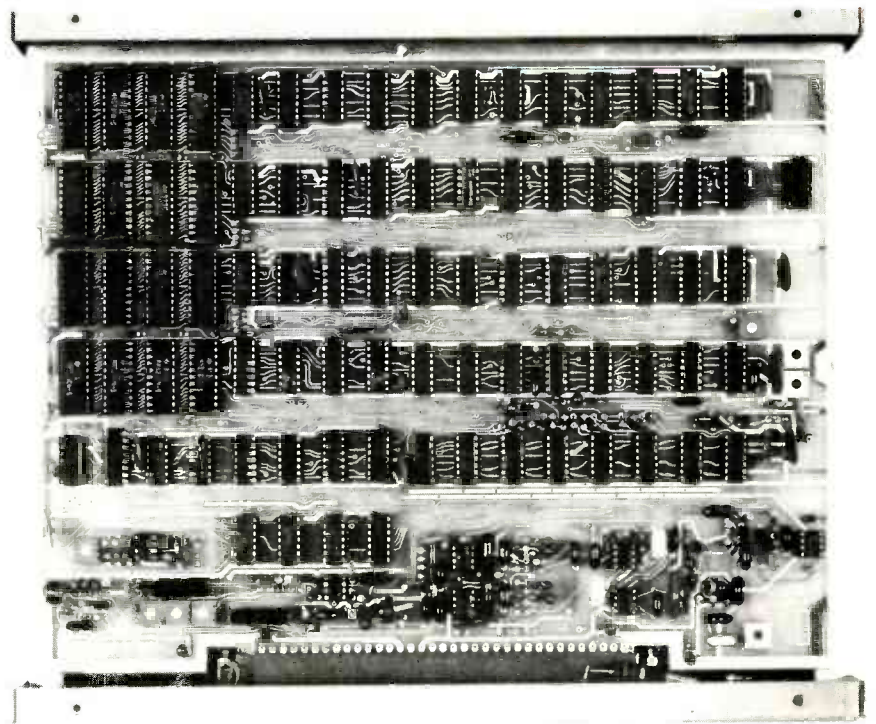


FIG. 11—THIS PHOTO shows how the main board should look when it is correctly assembled. It is shown here mounted in the enclosure.

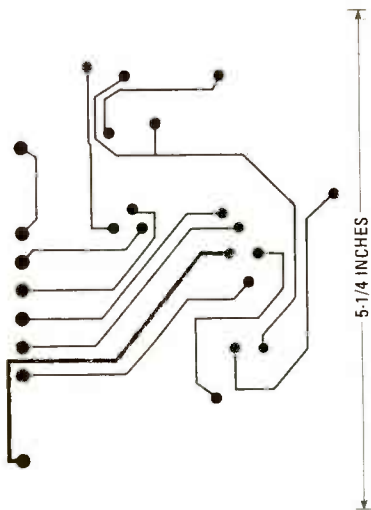


FIG. 12—FOIL PATTERN for top of telephone adaptor board.

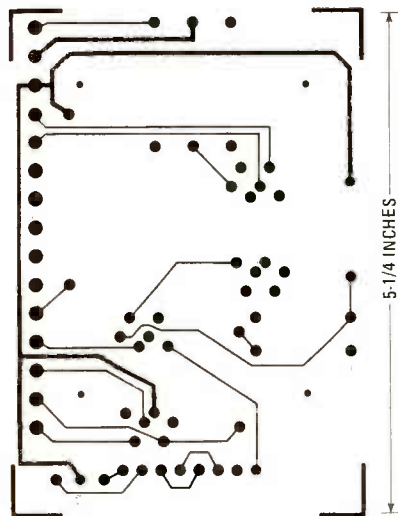


FIG. 13—FOIL PATTERN for bottom of telephone adaptor board.

C601, is oriented properly, and that the 8-terminal barrier strip is inserted so that the phone wires can be connected from the outside of the board. Using small PC-board pin-connectors at positions 1-15 will make it easier to make connections to the board later.

Most of the power supply, shown in Fig. 15, can be constructed on a piece of perforated construction board; the two large capacitors, C310 and C312, and the four regulators will be chassis-mounted and wired to the board. Be sure to allow for the many ground connections that will have to be made from that board.

The two off-board capacitors should be bracket-mounted to the chassis as shown in Fig. 15, and the regulators secured to the top side of the bottom of the case. Be sure that the tabs of the *positive* regulators make good electrical contact with the case, and be sure that the *negative* regulators are insulated from the case (use nylon hardware, mica insulators, and silicone grease).

When the three boards are complete, you can install the chassis-mounted com-

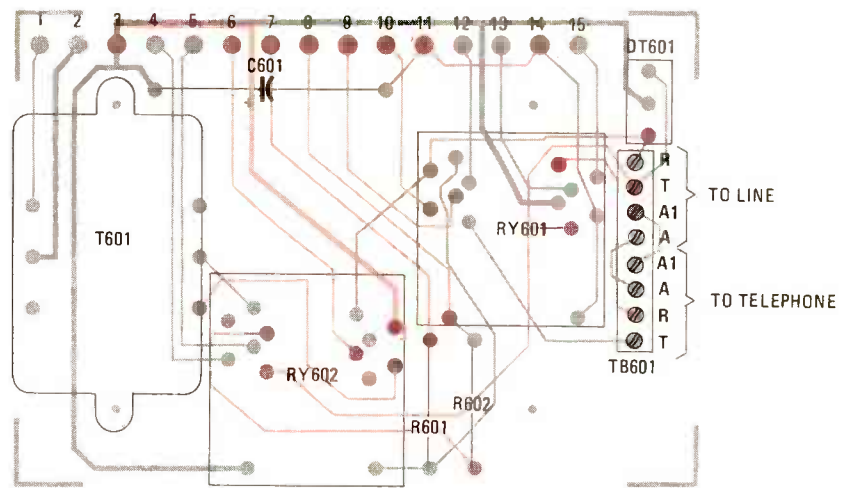


FIG. 14—USE SMALL PC-BOARD pin connectors at positions 1-15 to make it easier to connect wires to telephone adaptor board.

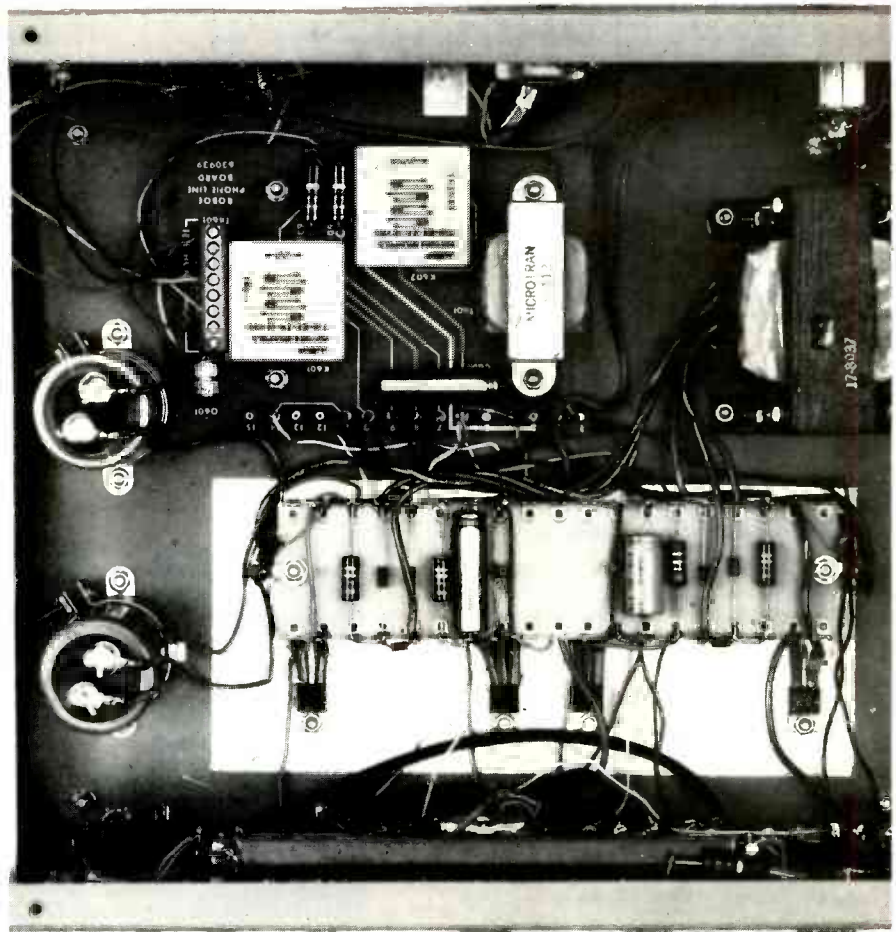


FIG. 15—POWER SUPPLY and associated components. Bottom of enclosure is used as heat sink for regulators.

ponents, such as the power transformer, switches, jacks, LED's, the two large capacitors, etc. It will probably be easier *not* to mount the 36/72-pin edge connector for the main board at this point, because doing so will make it awkward to make connections to it. You'll find that the liberal use of terminal strips will make routing of supply and control voltages more convenient.

Mount the power-supply board in the

case first, using standoffs, and connect it to the two large capacitors and to the regulators. Use "spaghetti" on the leads of the regulators, as shown in Fig. 15, for safety.

When we continue our look at the Picture Phone, we will finish up the construction of the device. We'll also look at how it is aligned as well as how it is used. Also covered will be how to connect it to the phone lines.

R-E

NEW IDEAS

DMM Add-On

ON MOST DMM'S, THE HIGHEST RESISTANCE range is 20 megohms. But if you need to read higher resistances you are usually out of luck. Here, however, is a simple add-on for your DMM that can solve that problem. The meter readout will have to be converted to read the resistance, but that's relatively easy to do, especially if you have a calculator.

tion of it and the meter's input impedance is the same 0.5025 megohms.

In use, the R_X terminals are shorted, and R2 is adjusted so that the DMM reads 8 volts when the DMM is switched to the appropriate range. Then the short is removed, the unknown resistance is connected to those R_X terminals, and the DMM is switched to the 200-millivolt

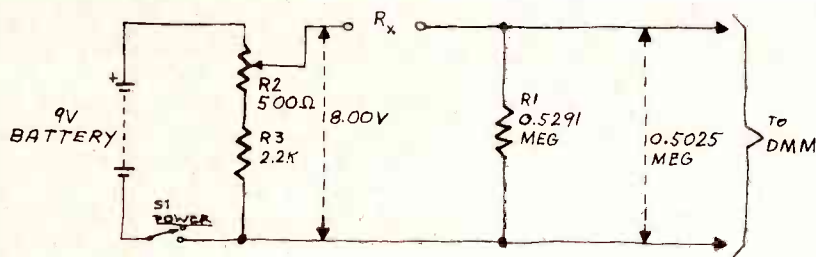


FIG. 1

The circuit is shown in Fig. 1. In it, the voltage from 9-volt battery is dropped across a voltage divider. Potentiometer R2 is adjusted so that the divider's output is exactly 8 volts. The odd value of R1, 0.5291 megohms, was chosen so that the parallel combination of it and the 10-megohm input impedance of the DMM equals 0.5025 megohms. If that is done, a 100-megohm resistance will result in a midscale reading on your meter (more on that later). As R1 is a non-standard value, it is formed by connecting either precision or selected 200K and 330K resistors in series. Note that the input impedance of some DMM's is not 10 megohms. If yours is one of those, R1 should be recalculated so that the parallel combina-

tion of it and the meter's input impedance is the same 0.5025 megohms. In use, the R_X terminals are shorted, and R2 is adjusted so that the DMM reads 8 volts when the DMM is switched to the appropriate range. Then the short is removed, the unknown resistance is connected to those R_X terminals, and the DMM is switched to the 200-millivolt

range. To find the resistance of the unknown, simply divide 4000 by the meter reading. The result is the resistance in megohms, including proper placement of the decimal point. That's all there is to it.

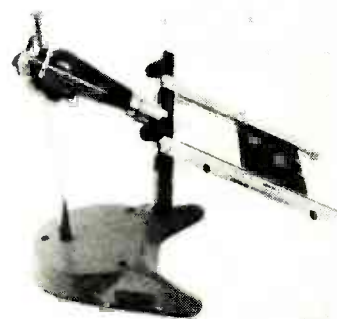
Here are two notes that may come in handy:

When checking leakage resistance of large capacitors, be sure that the capacitors have charged up completely before switching to the 200-millivolt range. Otherwise, you'll be subjecting your meter to the rather high voltage caused by the changing current. Also, for best results, wait a few minutes after switching on the add-on before adjusting R2. That will allow the circuit to stabilize.—Don R. King

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 333*—The Rapid Assembly Circuit Board Holder, having a retail price of \$39.95. It features an eight-position rotating adjustment, indexing at 45-degree increments, and six positive lock positions in the vertical plane, giving you a full ten-inch height adjustment for comfortable working. (See photo below.)



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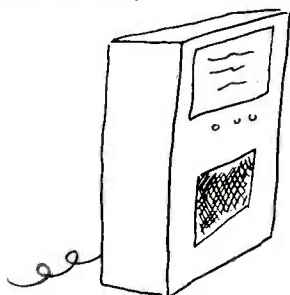
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HOBBY CORNER

And the winner is...

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

SEVERAL MONTHS AGO I TOLD YOU ABOUT some problems I had trying to help a friend build a small audio oscillator into an existing device (see the May, 1982 issue of **Radio-Electronics**). There was very little space and we had to find the smallest possible circuit.

As you may recall, I asked for your help and made it into a contest of sorts. That "contest" apparently caught the interest of many of you, as there were plenty of responses. To give you an idea of how tough the competition was, entries came from almost half of the states as well as from three countries.

The circuits themselves have been quite fascinating. Most were of expected types but a surprising number were unusual (or at least they used approaches that had not occurred to me). Many cir-

cuits used the 3909 LED flasher/oscillator, which indeed makes for a small device.

Also popular were transistor (bipolar and unijunction) circuits; all but a few of those used designs that eliminated the bulky audio transformer usually associated with such circuits. And, of course, there were a number of circuits using the 555 timer in an astable configuration. The rest of the circuits used less common techniques, and some were unique.

I would like to show you all of the different designs sent in but space will not permit that. Instead, I have included several of the circuits in Fig. 1 so that you can see some of the approaches used.

I hope you will try out some of those oscillators. Better yet, build and do a bit of experimenting with several of them—

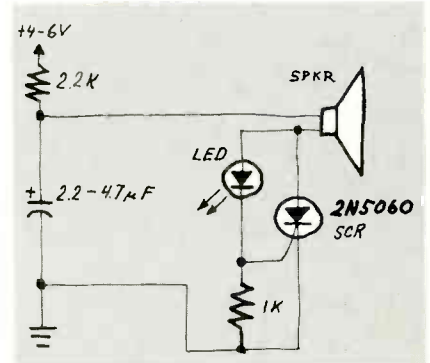


FIG. 1

find out how and why they work. If you can't do it right now, file the circuits away until you can, or at least until you need a small oscillator.

Getting back to the contest, you can imagine just how difficult it was to decide upon a winner. The one I eventually chose, shown in Fig. 2, was submitted by Peter Lefferts of San Martin, CA; it won out because of the unusual nature of the design.

As you can see from the schematic, the design certainly does not have the smallest parts count. However, as it uses a tear-drop-shaped tantalum capacitor, $\frac{1}{4}$ -watt resistors, and a sub-miniature LED, it is a *small* oscillator.

Congratulations to you, Peter; your "prize"—a box of miscellaneous components (there *may* even be something in

AN INVITATION

To better meet your needs, "Hobby Corner" will undergo a change in direction. It will be changed to a question-and-answer form in the near future. You are invited to send us questions about general electronics and its applications. We'll do what we can to come up with an answer or, at least, suggest where you might find one.

If you need a basic circuit for some purpose, or want to know how or why one works, let us know. We'll print those of greatest interest here in "Hobby Corner." Please keep in mind that we cannot become a circuit-design service for esoteric applications; circuits must be as general and as simple as possible. Please address your correspondence to:

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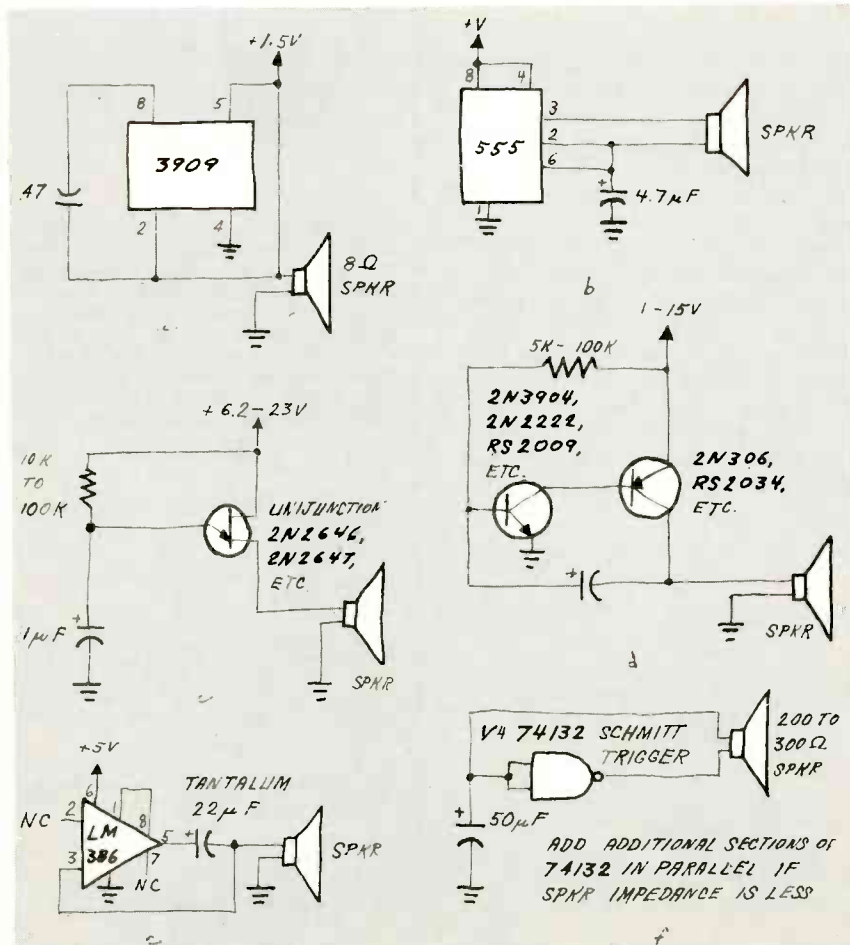


FIG. 2

there that you can use)—should have reached you by the time you read this.

Many thanks to all of you who entered the contest. My only regret is that everyone could not be a winner.

Another contest?

Many of you have said that you enjoyed working on Hobby Corner contests like that last one. I'll see what I can come up with along that line. In the meantime, if you have an idea for something that would make an interesting contest, pass your thoughts along.

In fact, it occurs to me that we can have a "contest" contest. Let's see who can come up with the best idea for a contest. This time, I'll let someone else pick the winner. Remember that speed may count, too (in case more than one of you submits the same winning idea, we will have to make the final decision on the basis of the postmark). And, by the way, *please* type or print your name and address clearly on your entry.

More on weather instruments

A few months back (November, 1981) this column presented information on building several types of weather instruments. Reader Mike Lozano (1100 Walnut Street, Des Moines, IA 50308) wrote about his plans for building a wind vane and an an-

emometer. Mike is a meteorologist and drew them up for viewers of his weather broadcasts. His plans are detailed and include part numbers. If you are interested in building these instruments, he will send you copies of his plans postpaid upon receipt of \$3.00. You might also want to ask him about the plans for the rain gauge he is working on.

Reader requests

Peter Stutz of Riehen, Switzerland is looking for a design for an amplifier for his frequency counter. He needs sensitivity of about 10 mV and a useful frequency range of from DC to 14 MHz.

Jere Welch (APO, NY) would like to find a circuit for an underwater pinger and surface receiver that could be used for marking wrecks.

Dave Beasley of Parachute, CO is wondering if there is any way to convert a battery-powered analog quartz clock with a 12-hour readout to one that has a 24-hour readout.

From Madera, CA, Richard Rodenbeck would like to build a programmable down-counter to control an irrigation system. What he would like is the one on his wife's microwave oven, but she won't let him anywhere near it.

Well, friends, those requests should keep you pretty busy until next month. See you then. R-E

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COMMUNICATIONS CORNER

Reading the mail

HERB FRIEDMAN, COMMUNICATIONS EDITOR

OCCASIONALLY THE MORNING MAIL brings some unsolicited material that screams for attention. Generally, I'll give anything a first reading; if it's aimed at the SWL, I'll read it twice because there isn't much written for SWL's, even though there's a lot of interest in shortwave listening. Recently, I received some booklets (if you can call 178 pages "a booklet") from the International DX'ers Club of San Diego, and I have yet to work my way through them once, even after giving them all my time on the morning commuter train.

Those booklets are obviously a labor of love from active DX'ers and SWL's, with feature articles on all aspects of shortwave listening, and reviews of all sorts of receivers, antennas, and whatever else could be useful for shortwave listening. The reviews are best described as "hard hitters," calling the shots as they see them.

Not every booklet is as thick; the average appears to be about 50 pages—but it's a well-packed 50 pages. Sample copies of the club's monthly bulletin are only \$1.00. If you're into SWL'ing, give yourself a treat and try a sample issue. Their address is The DX'ers Club of San Diego, 1826 Cypress St., San Diego, CA 92154-1151 (Yep! That's a 9-digit zip code).

Another kind of mail

Notwithstanding the so-called "leading edge of technology," most of the digital CW and RTTY "readers" have left me singularly unimpressed. The CW units could not track a sloppy fist, and when the fist was adequate, the readers often could not display longer words completely. If you've ever used one of

those you know how difficult it is to follow what's going on when you can read only bits and pieces at a time. As for RTTY, I have spent more time trying just to tune a reader to a signal than I have "reading the mail." Until now the best way to copy RTTY—at least for me—was with a real TU (Terminal Unit).

Well, technology has finally caught up with CW/RTTY readers in the form of the \$315.00 Kantronics *Mini-Reader*. That unit is small enough ($5\frac{3}{4} \times 3\frac{3}{8} \times 1\frac{1}{4}$) to fit it in an oversize shirt pocket, even though it has a 10-character fluorescent readout. Power for the unit (12-volts DC) is supplied by a wall-plug-type adapter. Each character readout has 14 segments, which allows the display of almost any alphanumeric character, including most special punctuation characters (although for some you need a rather flexible imagination).

Among other features, the unit can handle CW speeds of 3 to 80 words-per-minute (I think it's actually more precise at the higher speeds), RTTY at 60, 66, 75, and 100 words-per-minute, and standard ASCII at 110 or 300 baud. In addition, it does all RTTY decoding automatically at any frequency shift.

That's a lot of features for a shirt pocket—even a large one—and, what's more amazing, the thing works well. For one thing, the 10-character display is adequate, allowing a display of one or more complete words. The words move across the display from right to left. (It's amazing the difference two or three extra characters makes in "reading" the message.)

But, what's more important is the way the CW and RTTY signals are decoded.

Instead of using tricky digital timing-circuits, decoding is done by a pre-programmed microprocessor that recognizes character patterns. As the precise timing of the signal pulses is less important in this decoding technique, even reasonably sloppy fists can be decoded. At worst some characters might be lost or words might be run together. For RTTY, the touch of a button programs the word or baud rate. If you are unsure of the rate, it can be adjusted while watching the readout—when the displayed message becomes intelligible, you've found the proper rate.

Normally, RTTY uses two tones—one for the mark and one for the space. Here, only one of the tones—the mark tone—is used for decoding. What happens is that the microprocessor assumes the presence of the space when ever the mark is missing. That is a common "trick" used in RS-232C computer communications when only one power-supply polarity is available. Normally, the voltage pulses that create characters in computer communications alternate between approximately +15- and -15-volts. But if only a +15-volt supply is available, something must be done to compensate for the missing information. What is done is that a phantom bit is created—the computer is "tricked" into believing the -15-volt pulse is there anything the +15-volt pulse is missing. If it sounds confusing just imagine my reaction the first time I ran across a circuit that worked perfectly "with half the pulses missing."

The advantage of doing that with the decoder is that it allows the use of a highly selective bandpass filter ahead of the microprocessor; that filter screens out much of the natural and man-made noise that can prevent effective decoding.

Figure 1 shows how it works. The signal from the receiver's speaker or headphone output is bridged into an operational amplifier. From there, it is fed into two feedback bandpass filters and then into yet another amplifier that serves as a waveform shaper. The output of the shaper feeds through a low pass filter and on to a clamp that provides a pulse waveform at TTL levels for the microprocessor.

An LED in the clamp circuit serves as a tuning indicator. Normally, the LED is out when no signal flows to the clamp.

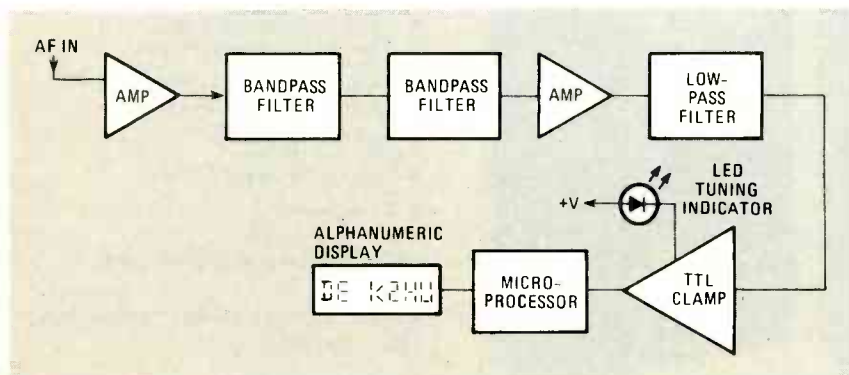
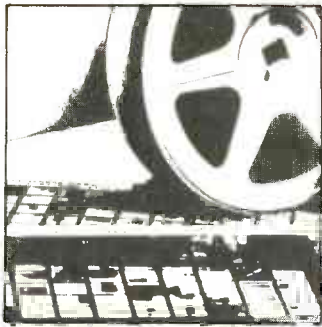


FIG. 1

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But, when the received signal is tuned so that the heterodyne tone falls within the decoder's passband, signal flow to the clamp begins. The increase in the clamp's collector current causes current to flow through the LED—the more current that reaches the clamp, the brighter the LED. To tune a signal, the user first adjusts the receiver tuning or BFO for maximum LED brilliance, and then adjusts the tuning until the display shows legible copy. It's not the easiest tuning system—but it's inexpensive; eventually you will be able to tune the thing easily by just listening to the pitch of the received tone.

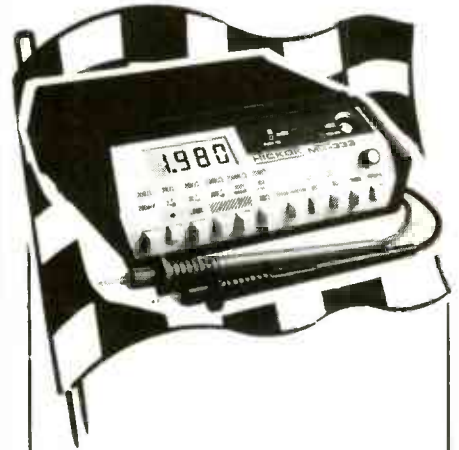
Kantronics sends out a nice package of information on the *Mini-Reader*. It's available from Kantronics, 1202 E. 23rd St., Lawrence, KS 66044. **R-E**



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ROBERT F. SCOTT, SEMICONDUCTOR EDITOR

I HAVE WONDERED, AND I SUPPOSE YOU have also, about the performance and the circuitry involved in those LSI audio-power amplifiers that are offered by a number of mail-order electronics supply houses. I haven't been able to come up with any technical data on those devices but was fortunate in running across an application note on a new and interesting device from National Semiconductor. It is the LH0101 low-distortion high-power wideband operational amplifier designed to deliver a high current into a variety of loads. It is conservatively rated at 2 amps with negligible crossover (zero-crossing) distortion. Frequency response is from DC to above 4 MHz. It is in a hermetically sealed TO-3 package. Table 1 shows the typical performance characteristics at 25°C ambient and a +15-volt supply.

The LH0101, shown schematically in Fig. 1, has three basic sections: an op-amp, buffer amplifier, and power amplifier. The op-amp uses a BI-FET configuration to take full advantage of the superior DC performance offered by the

FET input and the desirable slew rate, settling time, and low bias-current characteristics of this type of device. In addition,

TABLE 1

Parameter	Conditions	Value
Output current		2A
Input offset voltage		5mV
Input bias current		50pA
Input offset current		25pA
Input resistance		$10^{12}\Omega$
Large signal voltage gain		200V/mV
Output voltage swing	$R_L = 100\Omega$	$\pm 12.5V$
	$R_L = 10\Omega$	$\pm 11.6V$
	$R_L = 5.0\Omega$	$\pm 11V$
Slew rate	$A_V = +1$	10V/ μs
Full power bandwidth	$A_V = +1, R_L = 10\Omega$	300kHz
Small signal rise time	$A_V = +1, R_L = 10\Omega$	100 NS
Small signal settling time to 0.01%	$V_{IN} = 10V, A_V = +1$	2 μs
Gain bandwidth		4 MHz
Harmonic distortion	$f = 1kHz, P_O = 1W$	0.005%
	$R_L = 10\Omega, A_V = +1$	
	$f = 20kHz, P_O = 1W$	
	$R_L = 10\Omega, A_V = +1$	0.05%

the internal frequency compensation makes the BI-FET an ideal around which to design a power amplifier.

Most power amplifiers designed for high-current output over a wide frequency range are either designed for Class AB or Class B operation. Both of those designs have a tendency to produce crossover distortion. For minimum crossover distortion, a power amplifier must maintain a low output impedance throughout zero-crossing. To do that, the push-pull output transistors must smoothly drive the load, alternately switching current-sinking and current-sourcing duties at the crossover point.

In a Class-B configuration, both output transistors are completely cut off at the crossover point. Thus, output impedance is relatively high and crossover distortion is severe. In a Class-AB design, both output transistors are biased on during no-load conditions, thus providing a low output resistance and thereby eliminating crossover distortion.

However, in a Class-AB design, crossover distortion can develop with high-level input signals. For example, when the input-signal voltage causes full output current to be delivered to the load, the increased base-emitter voltage of the driving transistor tends to bias the resting transistor off. Now, when the input signal reverses polarity, so that the output swings negative, the amount of crossover

continued on page 156

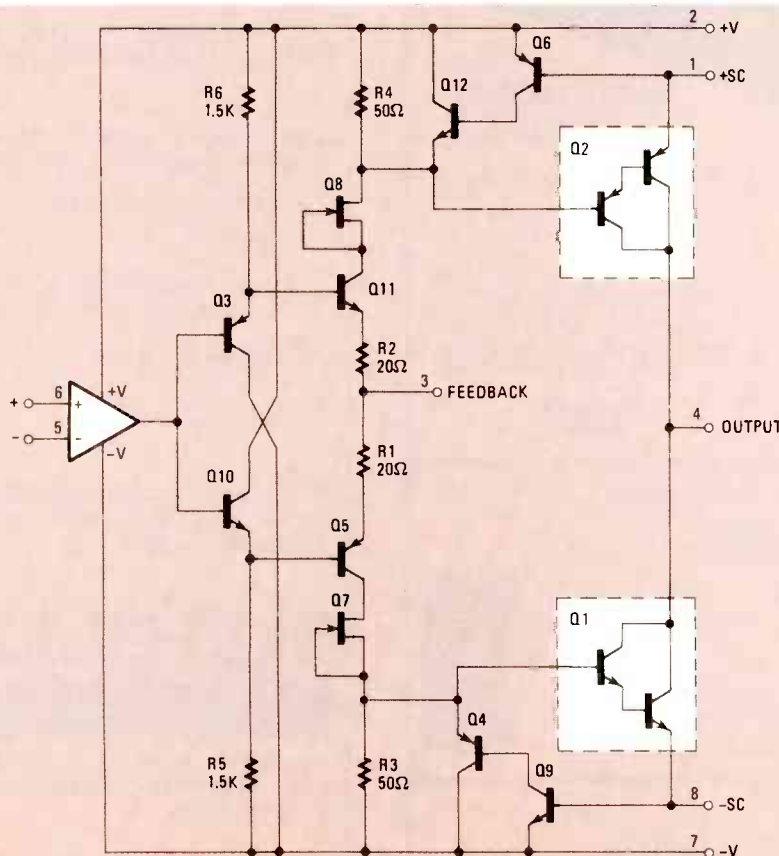
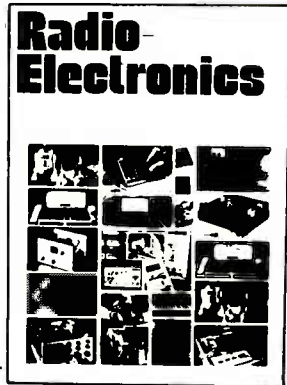


FIG. 1

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JACK DARR, SERVICE EDITOR

HOW MANY TIMES HAS THIS HAPPENED TO YOU? You change a shorted power transistor, operate the set long enough to be certain that everything is OK, and finally close up the back of the set. And in about a week the set is out again—only this time the new transistor has shorted. What goes on here? After all, you had used an exact-duplicate replacement.

Actually, there are several things that could have caused that. But among those is the possibility that the original transistor might not have been derated enough to hold up.

What does "derated" mean? The shortest definition for "derated" is "safety factor." When you find a power transistor shorted, check the applied DC voltage, and, after replacement, the current it's drawing. That is often shown on the schematic, which is a big help. Or, if the original is an EIA-type number (unlikely!) you can check for its breakdown-voltage and collector-current rating. Too many sets these days seem to be driving the power transistors almost up to the limit of their ratings; there is practically no safety factor allowed for surges, etc., which are always with us. Unlike tubes, transistors are very intolerant of surges.

So, what's the cure? Look up the original type in one of the many transistor guides and handbooks. Note its collector breakdown-voltage and maximum collector-current rating. Now, to increase the derating, go and look for another transistor of the same type, case, etc., but with a higher breakdown-voltage and collector-current rating. If the original had an 800-volt breakdown-voltage and a 2-amp collector-current rating, pick one with at least a 1200- or 1500-volt breakdown-voltage rating, and as high a collector-current rating as you can get. Some go up to as high as 20 amps, and that extra current-carrying ability is very useful. You've now derated the new transistor as much as possible to give it an extra margin of safety to deal with any surges or momentary overloads—those may have been what was killing the original transistors.

After the replacement, be sure to check for correct bias, drive signal, idling current, and so on. Check the current actually drawn in operation, and make sure that it is well within limits. Also—and this is very important—run it for a while and

then check the transistor's case temperature. Make sure that the screws are tight and that enough silicone grease was used. If it runs too hot, but other things seem to be fine, you may have to add more heat-sinking. That can be done in any of several ways. If you can't find any other way, bend a small piece of sheet aluminum into a "U" shape, and cement it to the top of the case as shown in Fig. 1. Make sure, of course, that it doesn't touch anything that could short it to ground.

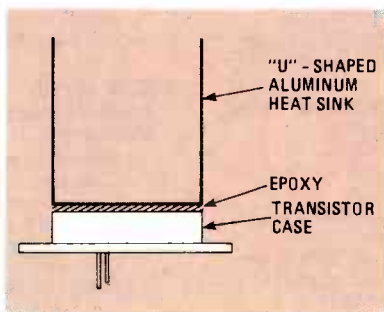


FIG. 1

Derating isn't limited to transistors; it applies to everything else in the set as well. If you find that a filter capacitor rated at 16 volts is always shorting, replace it with one rated at least a 25 volts—or better still, one rated at 50 volts. Doing that will give you much lower leakage and more ability to withstand surges. In some of the older sets, we were always finding that the coupling capacitor was leaky, causing distortion in the audio. Many of those were rated at only 400 volts; for replacement, we always used ones rated at 600 volts—with those there was far less leakage. (I once asked an engineer for one of the set manufacturers why capacitors rated at 600 volts weren't used. He said that they cost eight cents more, and, while they may not sound like much for one set, when you consider thousands of sets it begins to add up. Frankly, it still does not make much sense to me, but I guess that's the way they have to look at those kinds of things.)

Resistors should also be derated if they seem to fail too soon. The cure for that is to find out why the current is so high, and correct the problem. For luck, it won't hurt to increase the power rating of the resistor to make it a bit less likely to fail again. For instance, 1/4-watt resistors can be replaced by 1/2-watt units and 1/2-watt

ones can be replaced by resistors rated at 1 or even 2 watts, if space permits.

Let's look at one final thing before we finish up for this month. I get a lot of letters asking about power transformers for small import stereos, tape decks, etc. Often, there is just no service data available for those devices. It's easy enough to guess the voltage rating for those transformers; check the filter capacitors—if those are rated at 16 or even 25 volts, the chances are that the transformer's secondary was 12 volts. But what about the current rating?

Here's how to find out: Replace the unit's power-supply circuitry with a variable DC power-supply. Hook a DC voltmeter across the supply and a DC ammeter in series with it. Slowly bring up the power until the device begins to work. Note the voltage and current readings. Then turn the volume all the way up to find the maximum current. If that is 1.3 amps, for example, choose a transformer with at least a 2-amp rating to make certain that it can stand up. There you have it—the only possible problem here is physical size; be sure to check on how much space is available before obtaining a replacement.

R-E

SERVICE QUESTIONS

WEAK SOUND

I wrote you a while back about weak sound on this Katone 2100. You gave me some things to try and I did. Fed a signal to the volume control and traced it through the circuit with a scope. What I found was a defective transistor in the audio output. Replaced it and everything now works fine—thanks!—*Clement Guilbault, Derry, NH*

MISSING 3.58-MHz SIGNAL

Here's one that I ran into on my own bench a while back. The raster was good, but the picture had a pale greenish tint. There was no color in the picture. Tracing through the color stages, I found that there was no 3.58-MHz signal. The color bars were getting through fine. The burst signal was at the input to the crystal, but

not at the output. This circuit uses the crystal as a narrow bandpass "filter." So if the crystal is bad, there is no burst and no 3.58-MHz signal. There is no oscillator in this circuit; the burst itself is amplified to provide the reference signal. One caution here: Don't use a stock oscillator crystal in this type of circuit—only crystals cut for that application will do.

HOT FLYBACK

The main problem in this Sanyo 91C41 seemed to be a very hot flyback. You've always said "Check everything else, and if they are OK, it's the flyback." Well, everything else did check out OK, so I got my courage up and ordered a new one. Once that was put in everything worked fine.—David Daniel, Burbank, CA

MISSING CAPACITOR

This Sylvania EO-5 was continuously blowing output transistors; I think I finally tracked down the reason why. I found that R448 (3300 ohms, 1 watt) on the driver collector had burned up. I also noticed that C437, a .0047µF capacitor that was supposed to be between the base of the horizontal output and the emitter was missing. In fact, it appeared that it had never been there to begin with. Anyhow, I put one in and applied power using a Variac. Things are going much better

now—everything works including the +120-volt DC supply. The set has been going for several hours and none of the readings have changed.—John Ward, Mishawaka, IN

VERTICAL LINES

The vertical lines in the picture of this Sears 562/10121 show a distinct bend. That bend slowly moves up the picture from the bottom to the top. What is going on here?—D.G., Green Valley, AZ

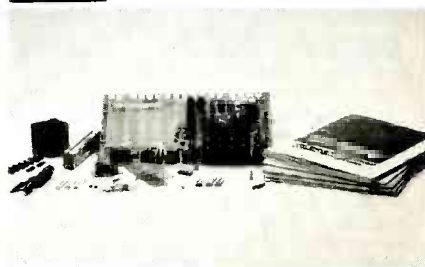
Well, I can't tell you exactly where the problem is, but I can tell what is causing it. What you are seeing is 60-Hz ripple that is getting into either the horizontal oscillator or the AFC. That causes a slight phase shift—just enough to make the vertical lines bend. To find the problem, use a scope on the DC power-supply and look for any sign of 60-Hz ripple. Keep the vertical gain of your scope high to spot any small ripple voltages.

PLASTIC CASE TRANSISTORS

A big problem with heating plastic-case transistors to find intermittents is that the cases tend to melt. To avoid that problem, place a piece of mica insulation between the tip of your soldering iron and the case. That will let you heat the transistor, but keep the case from melting—Gene Corn, Greenville, SC

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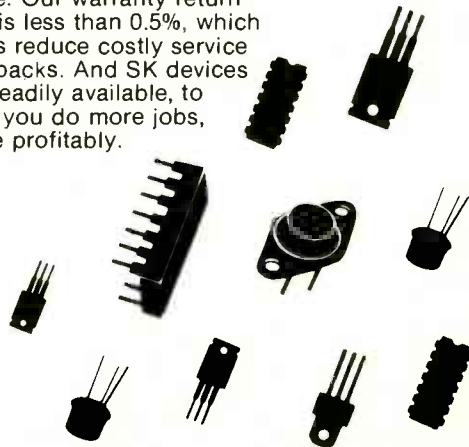
The *model TS-930S* is priced at \$1799.00.—**Trio-Kenwood Communications, Inc.**, 1111 West Walnut Street, Compton, CA 90220.

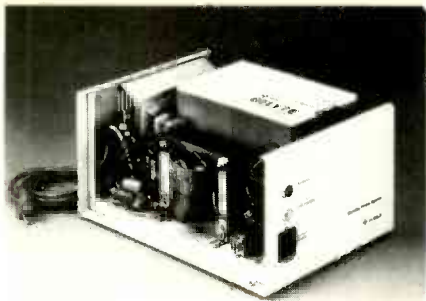
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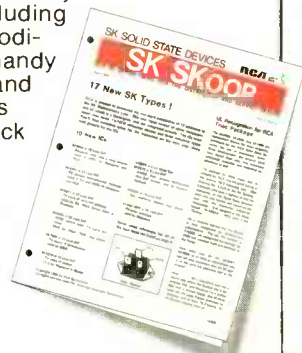
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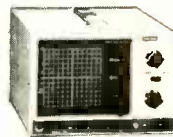


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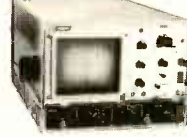
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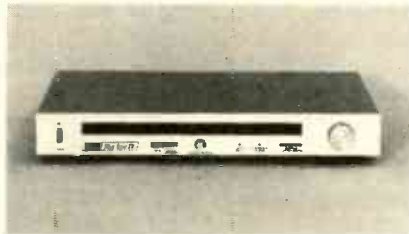


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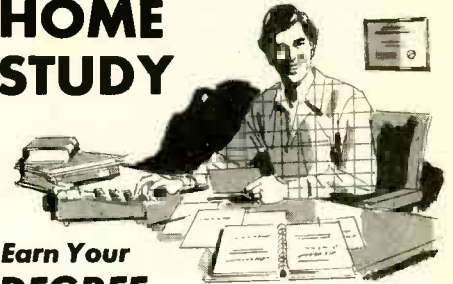


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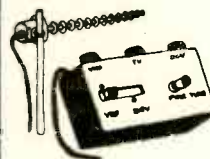
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STATE OF SOLID STATE

continued from page 148

distortion, if any, depends on how fast the resting transistor can turn on and assume its share of duty cycle. The condition worsens as the frequency of the input signal increases.

The output stage of the LH0101 combines both Class B and Class AB designs to achieve smooth distortion-free switching at the crossover point.

The buffer stage of the LH0101 (Fig. 1) is a unity-gain current amplifier consisting of transistors Q3-Q11 and Q5 and Q10. Operating in the Class AB mode, what the buffer does is to provide distortion-free drive during the zero crossing. Bandwidth extends beyond 50 MHz to eliminate the possibility of bandwidth-induced distortion.

FET's Q7 and Q8 limit the buffer-stage output current to 50 mA. However, the output stage, consisting of Darlington transistors Q1 and Q2, is set up so that both transistors turn on as the output-load current reaches 25 mA. Under operating conditions, the buffer drives the load at currents up to 25 mA. Above that point, the output stage takes over, delivering power up to the rated output limit. Thus, the power-driving ability of the buffer stage is used to "smooth" the turn-on delay of the output stage and eliminate crossover distortion.

Transistors Q6 and Q9 are in the circuit to prevent the output stage from being over-driven. Current-sensing resistors (R_{SC}) may be connected between the supply and sc terminals to set the limiting level. A drop of approximately 0.6-volt across a sensing resistor turns on either Q6 or Q9. That in turn, turns on Q12 or Q4, respectively, to prevent excess base current from driving the output stage beyond the design limit. Current-sensing resistors $R_{SC} = 0.6/I_{SC}$. When $I_{SC} = 2$ amps, $R_{SC} = 0.3$ ohms.

Low distortion 40-watt power amp

Figure 2 shows how two LH0101's can be used in a bridge configuration to obtain maximum available power output from a specified supply voltage. Amplifier distortion curves are shown in Fig. 3. A slew rate of 10 volts-per-μs extends the full-power bandwidth to beyond 100 kHz.

Application precautions

In this and other high-current high-power amplifiers, particular attention must be given to ground connections and the length and diameter of PC traces carrying high currents. Keep them short to minimize the development of error voltages. Figure 4 shows a suitable method of circuit grounding. The heavy lines represent paths or traces carrying high currents.

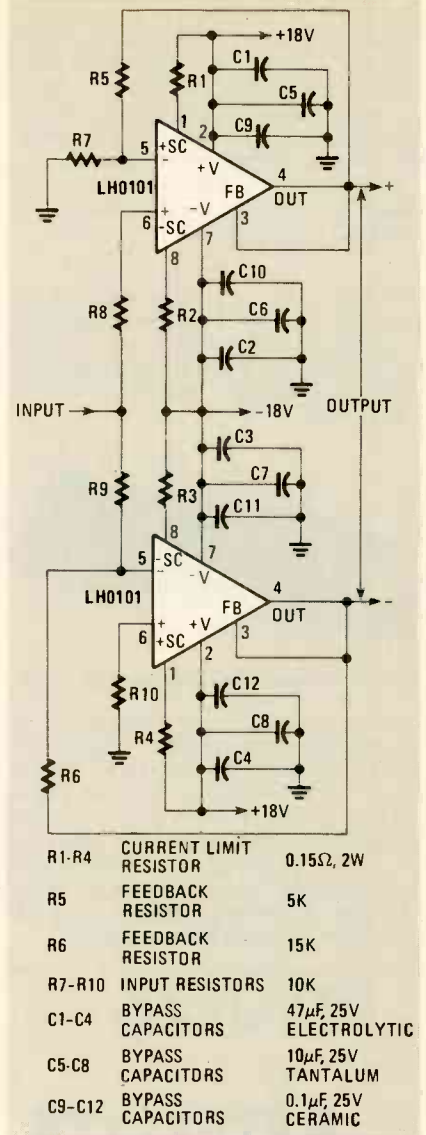


FIG. 2

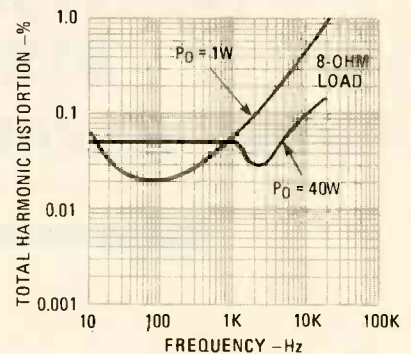


FIG. 3

The importance of minimizing error voltages can be seen as we examine the current-sensing circuitry in the amplifier in Fig. 2. The current-sensing resistors are R1, R2, R3, and R4; 0.15-ohm, 2-watt units that develop the 0.6-volt needed to trigger the current-limiting circuit. A PC trace with a resistance of only 10 milliohm (0.01 ohm) carrying 2 amps will develop a 20-mV error voltage. Add

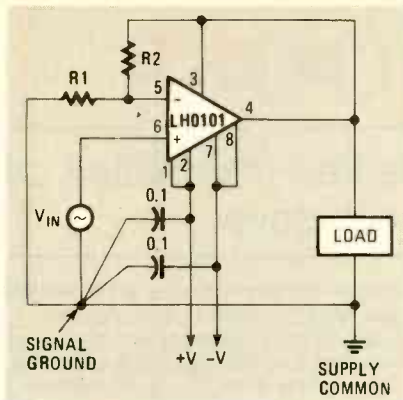


FIG. 4

to that the possible error voltages that may develop across the 5-milliohm resistance of a good solder joint and the 10-milliohm resistance of a socket contact.

A heat sink is a *must* to keep the LH0101's operating temperature within a safe range. It should have a thermal resistance of 3.5°C-per-watt ambient. A typical heat sink with that rating, and suitable for a TO-3 device package, is the Thermalloy 6141. It should be mounted with a mica insulator and a liberal application of a thermal-contact fluid or silicone grease.

Other applications

The LH0101 is ideally suited for service as a programmable current source, coaxial cable driver, CRT yoke driver,

and a driver for inductive loads. For information on adapting the device to those applications, refer to Application Note AN-261—*Low-Distortion Wideband Power Op Amp and LH0101 Power Operational Amplifier Data Sheet* available from National Semiconductor, 2900 Semiconductor Drive, Santa Clara, CA 95051.

Divide-by-four-prescaler

The RCA CA3199E divide-by-four prescaler takes signals in the VHF/UHF band (up to 1.3 GHz) and reduces them to low-frequency logic levels. The device's high sensitivity eliminates the need for preamplification in most cases. Applications include digital frequency synthesis in VHF/UHF receivers, frequency standards, and as high-frequency dividers in UHF timers and counters.

Accepting either single- or double-ended AC-coupled input signals, the CA3199E provides complementary emitter-follower outputs at standard ECL levels. With unloaded outputs, the typical logic 1 level is 4.2 volts while the logic 0 is 3.4 volts. The device operates from 5 ± 0.5 volts. The nominal input signal is a 100 mV sinusoidal waveform in the range of 100 MHz to 1000 MHz; the maximum RMS input voltage is 0.5 volt.

Transition time of logic output is 0.6 ns for both risetime and falltime. In an 8-pin mini-DIP, the device is \$2.79 at the 100-

piece level.—RCA Solid State Div., Box 3200, Somerville, NJ 08876.

Video Generator

Solid State Scientific has introduced the SND video generator that includes such desirable features as reverse video, underline, strikethrough, and character blink. It operates with the company's SND5037 CRT timer/controller to provide the display functions required of a video display terminal. The device has an expandable character set, video shift register, four character and graphics modes, and two programmable blink rates. The 28-pin device operates from a 5-volt supply, the price is \$15.95 in lots of 100.—Solid State Scientific, Inc., Montgomeryville, PA 18936.

Microminiature infrared LED

Motorola expands its line of infrared LED's with the addition of the MLED15 in a tiny clear plastic housing only 0.092 inch in diameter and 0.058 inch high. It has an output of 1.3 mW at a forward peak current of 30 mA. The peak emission wavelength is 930 nanometers so the MLED15 is physically and spectrally matched to the MRD150 phototransistor detector for use in interrupter modules and reflective couplers. The price is \$2.00 in 1-99 quantities.—Motorola Semiconductor Products Inc., PO Box 20912, Phoenix, AZ 80536. R-E

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TESLA—MAN OUT OF TIME, by Margaret Cheney, Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. 320 pages, including index, 6 x 9 inches, hard cover. \$16.95.

Nikola Tesla was probably the greatest of all American inventors. His alternating-current system, developed by a mind that could "see" the electric fields in space and thereby the rotating electromagnetic field, is the foundation of our modern civilization. His radio-frequency oscillation transformer (Tesla coil) was invented in 1891, and he demonstrated radio transmission and reception in 1893. In 1899 he demonstrated a radio-controlled boat in Madison Square Garden. In the same year, in his Colorado Springs laboratory, he produced electric discharges of over 12 million volts. His more than 900 patents range from therapeutics to mechanical engines.

Yet Tesla is practically unknown today. Why? The consensus seems to be that it was because he was a "loner" and built up no organization to carry on his name as well as his work, whereas the Marconi and Edison

companies had and have a vested interest in promoting the name of their founders.

Mrs. Cheney has done much to correct the impression of strangeness and alienation. She presents a Tesla quite different from the one we have seen in earlier works. Instead of a detached being, with no interest in commercial affairs, Tesla emerges as a person with very real worries, trying to find ways around his financial problems. His social life is well covered, and his non-technical writings (poetry and biographies of Yugoslavs he admired) are cited.

Mrs. Cheney's research appears to have been fantastic. She finds no evidence for the famous "\$1 million cash and \$1 per horsepower royalty" George Westinghouse is supposed to have offered him. Westinghouse records, Mrs. Cheney says, indicate that Tesla was paid \$60,000 for his 40 patents. The royalty was, however, \$2.50 per horsepower instead of \$1. That led to the confrontation in which Tesla tore up his contract. He was paid \$216,000 at that time, in lieu of royalties.

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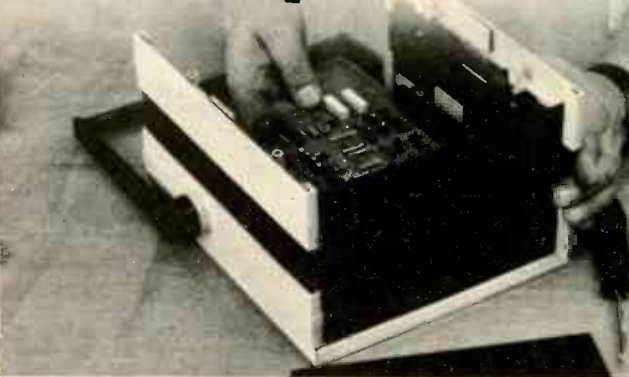
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equally in dispute, and Cheney is not sure that the facts were ever brought out. Another interesting story is that of the 200 lamps lit 26 miles away from his Colorado station. Tesla's notes, Cheney says, contain no mention of that feat.

In discussing Tesla's achievements, she goes into details that have not been made clear previously. Describing his robot boat of 1899, she points out that the remote radio control could be activated only by the simultaneous reception of two or more waves at different frequencies, rendering it invulnerable to outside jamming or interference.

She devotes a chapter to "The Great Radio Controversy" between Tesla and Marconi, resolved in Marconi's favor in 1915, but reversed by the Supreme Court in 1943 (after Tesla's death) with full acknowledgment that "Tesla had anticipated all others with his fundamental radio patents."

The Tesla turbine is covered in much greater detail than heretofore. The original model—about the size of a derby hat—weighed 10 pounds and produced 30 horsepower. It is still not certain whether it can be mass-produced practically with state-of-the-art materials. She also goes deeply into what happened to the "missing papers" in Tesla's safe after his death, devoting a full chapter to the subject.

With her diligent investigation into matters about which other authors have simply used the last writer's information without verification, or skimmed over, or overlooked entirely, combined with her sympathetic presentation of Tesla as a human being, Mrs. Cheney, and her book, have made an important contribution to the history of science.

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PRACTICAL TV TROUBLESHOOTING USING A VIDEO ANALYZER, by Robert L. Goodman. TAB Books, Blue Ridge Summit, PA 17214. 308 pages including appendix and index; 5 1/2 x 8 1/2 inches; hardcover; \$18.95.

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FIFTY BASIC EXERCISES, by J.P. Lamoitier. Sybex, 2344 Sixth Street, Berkeley, CA 94710. 231 pages, including appendices and index; 7 x 9 inches; softcover; \$12.95.

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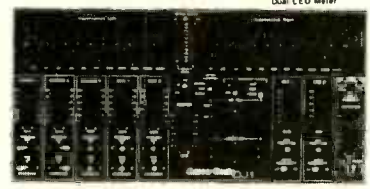
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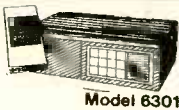


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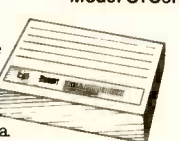
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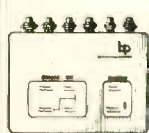
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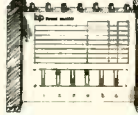
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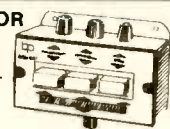
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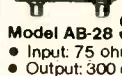


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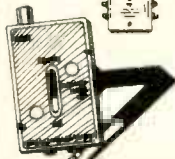
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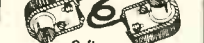
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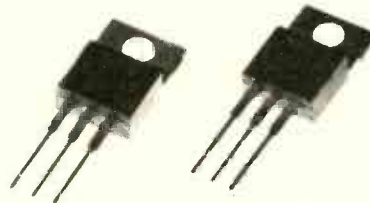
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2N1321 PNP GE TO 18	3-11.40
2N1322 PNP GE TO 18	3-11.40
2N1323 PNP GE TO 18	3-11.40
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2N1325 PNP GE TO 18	3-11.40
2N1326 PNP GE TO 18	3-11.40
2N1327 PNP GE TO 18	3-11.40
2N1328 PNP GE TO 18	3-11.40
2N1329 PNP GE TO 18	3-11.40
2N1330 PNP GE TO 18	3-11.40
2N1331 PNP GE TO 18	3-11.40
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2N1353 PNP GE TO 18	3-11.40
2N1354 PNP GE TO 18	3-11.40
2N1355 PNP GE TO 18	3-11.40
2N1356 PNP GE TO 18	3-11.40
2N1357 PNP GE TO 18	3-11.40
2N1358 PNP GE TO 18	3-11.40
2N1359 PNP GE TO 18	3-11.40
2N1360 PNP GE TO 18	3-11.40
2N1361 PNP GE TO 18	3-11.40
2N1362 PNP GE TO 18	3-11.40
2N1363 PNP GE TO 18	3-11.40
2N1364 PNP GE TO 18	3-11.40
2N1365 PNP GE TO 18	3-11.40
2N1366 PNP GE TO 18	3-11.40
2N1367 PNP GE TO 18	3-11.40
2N1368 PNP GE TO 18	3-11.40
2N1369 PNP GE TO 18	3-11.40
2N1370 PNP GE TO 18	3-11.40
2N1371 PNP GE TO 18	3-11.40
2N1372 PNP GE TO 18	3-11.40
2N1373 PNP GE TO 18	3-11.40
2N1374 PNP GE TO 18	3-11.40
2N1375 PNP GE TO 18	3-11.40
2N1376 PNP GE TO 18	3-11.40
2N1377 PNP GE TO 18	3-11.40
2N1378 PNP GE TO 18	3-11.40
2N1379 PNP GE TO 18	3-11.40
2N1380 PNP GE TO 18	3-11.40
2N1381 PNP GE TO 18	3-11.40
2N1382 PNP GE TO 18	3-11.40
2N1383 PNP GE TO 18	3-11.40
2N1384 PNP GE TO 18	3-11.40
2N1385 PNP GE TO 18	3-11.40
2N1386 PNP GE TO 18	3-11.40
2N1387 PNP GE TO 18	3-11.40
2N1388 PNP GE TO 18	3-11.40
2N1389 PNP GE TO 18	3-11.40
2N1390 PNP GE TO 18	3-11.40
2N1391 PNP GE TO 18	3-11.40
2N1392 PNP GE TO 18	3-11.40
2N1393 PNP GE TO 18	3-11.40
2N1394 PNP GE TO 18	3-11.40
2N1395 PNP GE TO 18	3-11.40
2N1396 PNP GE TO 18	3-11.40
2N1397 PNP GE TO 18	3-11.40
2N1398 PNP GE TO 18	3-11.40
2N1399 PNP GE TO 18	3-11.40
2N1400 PNP GE TO 18	3-11.40

TTLIC SERIES

7400	- 17	7472	- 35	74162	- 60
7401	- 17	7473	- 35	74163	- 60
7402	- 17	7474	- 35	74164	- 60
7403	- 17	7475	- 40	74165	- 60
7404	- 17	7476	- 40	74166	- 70
7405	- 24	7483	- 50	74170	- 1.60
7406	- 33	7485	- 65	74174	- 65
7407	- 35	7486	- 65	74175	- 60
7408	- 27	7487	- 65	74176	- 75
7409	- 24	7490	- 42	74177	- 75
7410	- 22	7492	- 45	74181	- 90
7411	- 22	7493	- 45	74182	- 95
7412	- 27	7496	- 60	74183	- 95
7413	- 27	7497	- 60	74184	- 95
7414	- 33	7498	- 60	74185	- 95
7415	- 33	7499	- 60	74186	- 95
7416	- 33	7499	- 60	74187	- 95
741					

TTL 74LS SERIES

74LS00N	21	74LS42N	44	74LS138N	55	74LS191N	85	74LS283N	84
74LS01N	22	74LS47N	72	74LS139N	55	74LS192N	74	74LS289N	99
74LS02N	24	74LS47A	35	74LS148N	139	74LS193N	74	74LS348N	1.65
74LS03N	24	74LS47A	35	74LS151N	43	74LS194N	74	74LS362N	9.95
74LS04N	25	74LS47N	45	74LS153N	42	74LS221N	89	74LS355N	5.9
74LS05N	25	74LS47N	44	74LS155N	87	74LS240N	1.19	74LS366N	5.9
74LS06N	25	74LS47N	89	74LS157N	48	74LS241N	1.19	74LS367N	5.9
74LS09N	25	74LS47N	38	74LS158N	48	74LS242N	1.19	74LS368N	5.9
74LS10N	24	74LS50N	42	74LS160N	79	74LS243N	1.19	74LS369N	5.9
74LS11N	28	74LS52N	54	74LS161N	75	74LS244N	1.25	74LS374N	1.96
74LS12N	25	74LS53N	54	74LS162N	69	74LS245N	1.95	74LS375N	1.96
74LS13N	36	74LS56N	32	74LS164N	89	74LS253N	56	74LS377N	1.25
74LS14N	48	74LS107N	42	74LS165N	89	74LS255N	69	74LS378N	1.25
74LS20N	29	74LS112N	36	74LS166N	1.64	74LS257N	69	74LS390N	1.44
74LS21N	27	74LS122N	45	74LS170N	1.59	74LS259N	1.49	74LS393N	1.44
74LS22N	25	74LS123N	69	74LS173N	74	74LS266N	42	74LS447N	8.9
74LS23N	34	74LS125N	49	74LS174N	74	74LS266N	1.19	74LS504N	1.58
74LS30N	34	74LS125N	49	74LS174N	74	74LS266N	1.19	74LS504N	1.58
74LS32N	27	74LS132N	58	74LS175N	45	74LS279N	44	74LS670N	1.36
74LS38N	28	74LS133N	49	74LS189N	4.45	74LS280N	1.96		

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74F00PC	96	74F11PC	96	74F158PC	2.16	74F258PC	2.34
74F02PC	96	74F109PC	1.20	74F182PC	3.30	74F352PC	2.34
74F04PC	1.11	74F139PC	1.16	74F191PC	4.50	74F353PC	2.34
74F08PC	96	74F139PC	2.16	74F243PC	2.25	74F373PC	5.85
74F10PC	96	74F157PC	2.16	74F257PC	2.34	74F534PC	5.85

HIGH SPEED CMOS

74HC00N	64	74HC74N	1.15	74HC163N	2.25	74HC244N	4.35
74HC02N	64	74HC76N	1.15	74HC164N	2.25	74HC245N	4.35
74HC04N	64	74HC107N	1.15	74HC166N	2.75	74HC259N	2.95
74HC08N	64	74HC138N	1.95	74HC174N	2.15	74HC273N	4.35
74HC10N	64	74HC139N	1.95	74HC175N	1.15	74HC378N	1.45
74HC11N	64	74HC151N	2.20	74HC192N	1.95	74HC366N	1.45
74HC20N	64	74HC155N	2.20	74HC193N	1.95	74HC367N	1.45
74HC21N	64	74HC157N	1.45	74HC194N	2.25	74HC368N	1.45
74HC27N	75	74HC162N	2.25	74HC240N	4.60	74HC369N	1.45
74HC32N	75	74HC162N	2.25	74HC241N	5.00	74HC373N	3.95
74HC42N	1.60	74HC161N	2.25	74HC242N	1.95	74HC375N	2.40
74HC51N	65	74HC162N	2.25	74HC243N	1.95	74HC390N	2.95
						74HC393N	2.95

CMOS

4001	26	4052	26	4047	1.05	4081	26	4532	1.20
4002	26	4024	75	4049	55	4083	61	4539	1.90
4006	99	4025	26	4051	90	4093	70	4543	5.53
4009	46	4026	1.95	4052	95	4104	3.75	4545	5.53
4011	26	4027	60	4053	95	4510	98	4556	7.5
4012	25	4028	75	4050	90	4511	90	4562	9.2
4013	51	4029	90	4066	34	4512	90	4584	6.5
4014	83	4030	65	4068	34	4514	1.99	4585	8.1
4015	83	4033	2.70	4069	26	4516	96	4785	1.45
4016	47	4034	2.70	4070	26	4517	2.15	4787	1.45
4017	90	4035	1.10	4071	28	4520	85	74C161	1.20
4018	80	4040	95	4072	26	4522	1.20	74C163	1.20
4019	65	4041	90	4073	26	4526	1.50	74C173	1.60
4020	94	4042	90	4075	26	4527	1.20	74C193	1.20
4021	82	4044	87	4076	90	4528	1.07	80C97	3.75
4022	95	4045	99	4078	32	4528	1.07	80C98	6.9

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311TC	49	393TC	49	1488PC	1.09	N426N	1.09
317KC	2.59	555TC	27	1489AFC	.64	SN76477N	2.75
317UC	1.59	556PC	68	2211PC	2.89	SN76489N	7.39
318TC	1.39	567TC	89	2340PC	1.39	SN76489AN	5.29
323KC	1.59	567TC	89	3081PC	1.39	ULN2803AN	9.9
324PC	48	725TC	1.60	3086PC	.59	XR210CN	4.09
339PC	48	733PC	96	3302PC	.69	XR2206CP	3.75
		7414C	56	3403PC	1.19		

KC = TO3, UC = TO20, HC = TO5, TC = 8 PIN MINI DIP, N or PC = DUAL IN LINE IC

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2N699	.40	2N218A	.35	2N3053	.35	2N3962	.42
2N706	.24	2N219A	.35	2N3054	.67	2N3964	.65
2N718A	.29	2N221A	.19	2N3055	.75	2N4033	.82
2N914	.20	2N222A	.25	2N3135	.40	2N4036	.65
2N916	.37	2N2270	.45	2N3250A	.30	2N4037	.65
2N918	.55	2N2389A	.25	2N331A	.34	2N4093	.59
2N930	.27	2N2405	.65	2N3467	.62	2N4208	.44
2N956	.53	2N2484	.27	2N3724	.49	2N4209	.44
2N1304	.79	2N2904A	.32	2N3725	.64	2N5038	4.50
2N1613	.98	2N2905A	.65	2N3771	1.50	2N5039	3.95
2N1711	.35	2N2906A	.19				

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	44	47	51	59	79
3 AMPS	KBPC102	KBPC104	KBPC106	KBPC108	KBPC110
	85	91	98	1.09	1.25
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S10K40	V682A	.98	.98
S10K50	V822A	.98	.98
S14K130	V130LA10A	1.20	1.20
S14K150	V130LA10A	1.20	1.20
S14K250	V250LA15A	1.65	1.65
	TL064CN	1.66	1.66
	TL071CP	.68	.68
	TL072CP	.68	.68
	TL074CN	1.79	1.79
	TL081CP	.54	.54
	TL082CP	.99	.99
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	TL431CLP	.73	.73
	TL497ACN	3.60	3.60

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P6116-20	16K (2K x 8)	200NS 24 PIN (CMOS)	15.95
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P4060-30	4K (4K x 1)	300NS 22 PIN	3.65
C4116-20	16K (16K x 1)	200NS 16 PIN Ceramic	2.95
P4116-20	16K (16K x 1)	200NS 16 PIN	1.95
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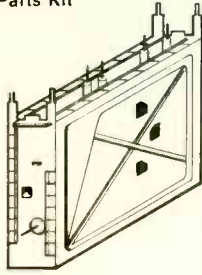
6330/82S23	32 x 8	Open Collector	16 PIN	2.45
6331/82S123	32 x 8	Tristate	16 PIN	2.45
93417/82S129	256 x 4	Open Collector	16 PIN	2.45
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CHANNEL 14-83
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75 OHM INPUT

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1.9-2.5 GHz



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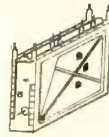


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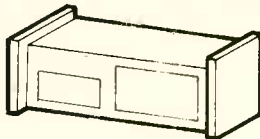
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MICROWAVE downconverters. Also UHF subscription TV kits. Catalog 20c. **TROJAN ENTERPRISES**, 2920 Shelby, Indianapolis, IN 46203

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CABLE TV SECRETS—the outlaw publication the cable companies tried to ban. HBO, Movie Channel, Showtime, descramblers, converters, etc. Suppliers list included. Send \$7.95 to **CABLE FACTS**, Box 711-R Pataskala, OH 43062

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POWER-AMP sub-assemblies, 100 watts rms. .05% distortion, completely assembled and tested, quantity pricing available, free brochure. **CLAXTON AUDIO**, 3174 Periwinkle, Memphis, TN 38127

RECORD - tapes! Discounts to 73%; all labels; no purchase obligations; newsletter; discount dividend

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the first name in Counters!



9 DIGITS 600 MHz \$129⁹⁵ WIRED

PRICES:

CT-90 wired, 1 year warranty	\$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

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 \$99⁹⁵ WIRED



SPECIFICATIONS:

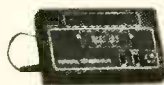
Range: 20 Hz to 525 MHz
 Sensitivity: Less than 50 MV to 150 MHz
 Less than 150 MV to 500 MHz
 Resolution: 1.0 Hz (5 MHz range)
 10.0 Hz (50 MHz range)
 100.0 Hz (500 MHz range)
 Display: 7 digits 0.4" LED
 Time base: 1.0 ppm TCXO 20-40°C
 Power: 12 VAC @ 250 ma

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 \$79⁹⁵ 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 \$159⁹⁵ WIRED



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 \$99⁹⁵ 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: 25 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3 1/2 digit, 1/2 inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt 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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For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

\$29.95 Kit \$39.95 Wired

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Telescopic whip antenna - BNC plug	\$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal.	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

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• MINI SIZE: 8 1/4" X 12"
INCLUDES DUST COVER AND PLASTIC CASE (NOT PICTURED) WITH FRONT CUT OUT TO FIT STEREO UNIT (NOT INCLUDED).
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1700 mfd. 150VDC \$2.00
2 1/2" DIA X 4 3/4" HIGH
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6,400 mfd. \$2.50
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18,000 mfd. 75VDC \$4.00
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25,000 mfd. 75VDC \$4.50
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72,000 mfd. 15VDC \$3.50
2" DIA. X 4" HIGH
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ALL ARE 115VAC PLUG IN

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ANTENNA INPUT 300 OHMS
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INTERLOCKING ASSEMBLY 4-D.P.D.T./7-4-P.D.T.
6 1/2" MOUNTING CENTERS \$3.00 PER ASSEMBLY

6 VDC RELAY

MINIATURE D.P.D.T.
3 AMP CONTACTS
FUJITSU # FBR321D006
\$1.75 EA 10 / 16.00

13 VDC RELAY

CONTACT: S.P.N.C.
10 AMP @ 120 VAC
ENERGIZE COIL TO OPEN CONTACT...
COIL: 13 VDC 650 OHMS....
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5 STATION

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ALL ARE .156" SPACING

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\$189

60 CHANNELS



It turns the set on/off, fine tunes the picture, tells the time, selects channels at random or in sequence, pre-sets any number of favorite channels, and pre-sets on/off times up to 24 hours ahead. 547ZA018

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Restores your VCR's capability for programming. Restores remote channel control. Enables videotaping of one cable program while watching another. 547VA950

THE AMAZING 60 CHANNEL JERROLD 400 WIRELESS CABLE TV CONVERTER

DEALERS WANTED

ONLY 169⁹⁵
159.95 EA./5

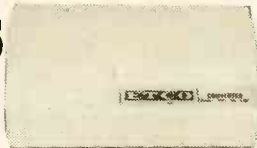


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OUR NEW 30 CHANNEL
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39⁹⁵

\$34.50 EA./5



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Converts mid & super band cable channels for viewing on your TV set!

MIDBAND BLOCK CONVERTERS



39⁹⁵
YOUR CHOICE

547VA277... Midband to lowband 3-channel.
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Includes remote TV on/off switch and fine tuning control. 20 FT control cable. 547VB553

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**THE ETCO MICRO 1000
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NEW!

69⁹⁵



Equivalent to or better than: Vidcor 2000, Philips CTC-2, Magnavox MX-40CC, Lindsay V2U, Rhodes CO-500, Philips CTC-30, Winegard VC-7600 and others... 547VB114

As above - with Vernier tuning: adjustable tuning insures total tracking compatibility with all TV sets. 547VC477... 79.95

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ONLY 49⁹⁵
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19⁹⁵

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**NEW!
59⁹⁵**



Neat low loss switching unit selectively feeds 6 different video sources to your TV set. Also possible to watch one source while viewing another. 547VA045

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Kwik disconnect cables with "F" connectors - Very low insertion loss, because there are no switches. One time hook for VCR, TV, Game, Cable, etc. - Attractive brown & wood grain. Compact size: 6" x 4-1/2" D x 3" H.

29⁹⁵
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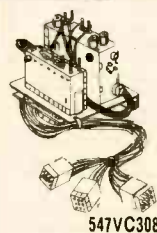


The easy & efficient method for multiple connections for your VCR-TV, ANT/AUX-TV Game, etc. 547VC357

NEW

BRAND NEW FACTORY SURPLUS VHF/UHF VARACTOR TUNER ASSEMBLY

PRICE CUT 29⁹⁵



* Admiral assembly No. NC 3143-1 Tandem - side by side VHF and UHF tuners made originally for Admiral. Numbers that appear on the tuners are: 294-7829, 8227AAFA, 94C725-2, 294-7831, 8132AAFB.

547VC308

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AT ETCO

An ETCO exclusive! Combines both instruments in one. It works like a charm! Try one on our 30 day money back guarantee!

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TV/FM SIGNAL BOOSTER FOR CABLE OR OFF AIR USE improves TV and FM by restoring signal loss which happens during basic VCR installations and multiple set installations. 75 ohm. 547VA103 17.95 EA./5

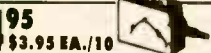
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- 547VC930... OAK RT35 (jewel box) 36 channel remote (used-guaranteed) \$69.95
- 547VB359... OAK L35 set top 35 channel converter (used-guaranteed) \$89.95
- 547VA963... Used (as-is) OAK V26 26 channel cable TV converters \$39.95
- 547VA995... Used (as-is) TOCOM DC1000 remote control 20 channel converter \$29.95

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4⁹⁵
\$3.95 EA./10

Brand new production surplus. All solid state. Ideal for experimental work building cable TV converters, etc. 547SU099



547VA966... As above with diodes 4.99
547SU285... Solid state VHF tuners. 5.95

VHF/FM 75 OHM TO 300 OHM MATCHING TRANSFORMERS

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Very popular. Use to couple and match cable TV to TV set. Also couples VCR machines, TV games etc. 5-300MHz 547AE380 \$2.29, \$1.95 ea./5
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\$40.01 to \$60.00	5.46	6.51	7.77	7.77	10.81	10.81
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11055	24	\$ 4.35	\$ 3.90	\$ 3.60
11056	28	4.50	4.05	3.75
11057	40	5.95	5.35	4.95
11058	64	10.50	9.45	8.70

RESISTOR ASSORTMENT 82508 - 700 pcs (1 each below assortment) \$22.50

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Stock No.	Qty.	Length (feet)	Weight (oz.)	Price
50075	.062	9	1.5	\$3.28
50076	.062	25	4	4.36
50077	.062	50	8	6.02
50078	.032	33	1.5	4.08
50079	.032	88.5	4	5.16
50080	.032	175	8	6.82

TI WIRE WRAP SOCKETS

Tin plated phosphor bronze contact - 3 wrap

Stock No.	No. Pins	1-24	25	100
11301	8	\$ 4.55	\$.40	\$.38
11302	14	.66	.59	.54
11303	16	.72	.64	.58
11304	18	.82	.73	.68
11305	20	1.11	.99	.90
11306	22	1.26	1.12	1.02
11307	24	1.41	1.25	1.14
11308	28	1.71	1.52	1.38
11309	40	2.31	2.05	1.86

TI LOW PROFILE SOCKETS

Tin plated phosphor bronze contact pins with gas light seal

Stock No.	No. Pins	1-24	25	100
11201	8	\$ 1.15	\$.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	.38	.34	.29
11209	40	.53	.45	.40

ELPAC POWER SUPPLIES - DC/DC CONVERTERS

SINTEC Stock No.	ELPAC Part No.	Input Voltage (VDC)	Output Voltage (VDC)	Output Current (Amps)	Dimensions (HxWxD) in inches	Price
13823	CB3801	3.0-7.0	12.0-6	0-25	48x51x3.05	\$ 7.95
13828	CB3811	3.0-7.0	-12.0-6	0-25	48x51x3.05	7.95
13827	CB3802	3.0-7.0	15.0-7	0-20	48x51x3.05	7.95
13828	CB3812	3.0-7.0	-15.0-7	0-20	48x51x3.05	7.95
13829	CB3804	3.0-7.0	28.0-7	0-10	48x51x3.05	7.95
13830	CB3814	3.0-7.0	-28.0-7	0-10	48x51x3.05	7.95

1.5 W TYPE

13831	CL3801	4.0-7.0	12.0-6	125	85x11.2x1.77	59.95
13832	CL3811	4.0-7.0	-12.0-6	125	85x11.2x1.77	59.95
13833	CL3802	4.0-7.0	15.0-7	100	85x11.2x1.77	59.95
13834	CL3812	4.0-7.0	-15.0-7	100	85x11.2x1.77	59.95
13835	CL3804	4.0-7.0	28.0-7	50	85x11.2x1.77	59.95
13836	CL3814	4.0-7.0	-28.0-7	50	85x11.2x1.77	59.95

13821-1 Data Sheet for 13801 \$2.25

13825-1 DATA SHEET FOR DC/DC CONVERTERS 25

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13731 0-50A 39.50
13732 0-100A 39.50

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Stock No. 13727 **\$9.95**

ELPAC POWER SUPPLIES - SOLV SERIES FULLY REGULATED

SINTEC Stock No.	ELPAC Part No.	Input Voltage (VDC)	Output Voltage (VDC)	Output Current (Amps)	Dimensions (HxWxD) in inches	OVP	Price
13802	SOLV15-5	5	3.0A	4.7/18x42	Fixed included	39.95	
13803	SOLV15-12	12	1.5A	4.7/18x42	Fixed included	39.95	
13804	SOLV15-15	15	1.2A	4.7/18x42	Fixed included	39.95	
13805	SOLV15-24	24	0.75A	4.7/18x42	Fixed included	39.95	
13806	SOLV30-5	5	6.0A	5-5/8x47/8x3-3/16	OVP-4	59.95	
13807	SOLV30-12	12	6.0A	5-5/8x47/8x3-3/16	OVP-4	59.95	
13810	SOLV30-15	15	3.3A	5-5/8x47/8x3-3/16	OVP-4	59.95	
13812	SOLV30-24	24	2.0A	5-5/8x47/8x3-3/16	OVP-4	59.95	

13802-1 Data Sheet for SOLV Series 25

PIN FORMING TOOL

puts IC's on their true row to row spacing. One side is for .300 centers. Flip tool over for devices on .600 centers. Put device in tool and squeeze.

ONE TOOL DOES 8 Thru 40 PINS!
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Nutdriver Kit
7 most popular sizes - 3/16", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8"

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3 Amps at 125VAC

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It's the DVM That "Thinks"!

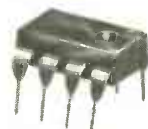
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NEW!
Frequency Compensated

Low As
179



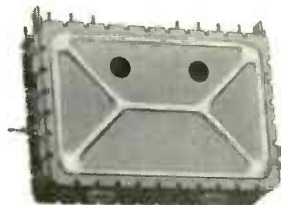
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3/4	270-1222	.99
1	270-1223	.99
1.5	270-1224	.99
2	270-1225	.99
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Pkg. of 2 **199**

One red, one green. Built-in dropping resistors for 120VAC. Mount instantly in 7/16" holes. 272-709 Pkg. of 2/1.99

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3/8 x 9/16 x 3/8"

Fits 14-pin DIP socket or mounts on PC board. SPDT contacts. 2 amps at 125VAC. 72 mA, 70-ohm coil. 275-243 2.99

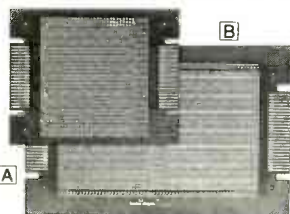
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Fig.	Connectors	Contact Points	Size	Cat. No.	Each
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B	40 position	2898	5 1/4 x 8 1/4	276-165	9.95
B	50 position	2898	5 1/4 x 8 1/4	276-166	9.95

- 40-Pin Card Edge Socket. Solder eyelets. 276-1544 2.59
- 50-Position Card Edge Socket. Solder eyelets. 276-1545 2.99
- 40-Position Socket With 12" Cable. 276-1542 4.99
- 50-Position Socket With 12" Cable. 276-1543 5.49
- 40-Position Header. 276-1540 1.29
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PC-Mount Piezo Buzzer

NEW! **249**



Great for security, use in clock radios, digital projects and more. 3.0-20VDC. 12 milliamps at 12VDC. 17.5 x 4.5mm diameter. 273-065 2.49

Micro-Mini 5VDC Relay

NEW! **249**



Just 1 1/32 x 3/8 x 1/4", and ideal for crowded boards with .100" centers. SPDT contacts: 1 amp at 125VAC. 55-ohm, 90 mA coil. 275-240 2.49

Actual Size

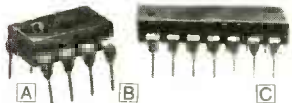
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Table listing various integrated circuits (ICs) under the 7400 series, including part numbers, pin counts, and prices.

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Table listing microprocessor components, categorized into Static RAMs, Dynamic RAMs, EPROMs, Microprocessor Chips, and Microprocessor Manuals.

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Table listing various ICs from the INTER-SIL brand, including part numbers, pin counts, and prices.

Table listing various ICs under the 74LS series, including part numbers, pin counts, and prices.

Table listing various ICs under the 8000/8080A series, including part numbers, pin counts, and prices.

Table listing various ICs under the 74C-C/MOS series, including part numbers, pin counts, and prices.

Table listing various ICs under the 74S/PROMS series, including part numbers, pin counts, and prices.

Table listing various ICs under the National EPROM-RAM Sale, including part numbers, pin counts, and prices.

Table listing various ICs under the Linear series, including part numbers, pin counts, and prices.

Table listing various ICs under the CA-Linear series, including part numbers, pin counts, and prices.

Advertisement for IC Sockets, featuring a large graphic of a socket and text describing the product and company information.

Table listing various capacitors, including electrolytic and ceramic types, with specifications and prices.

RADIO-ELECTRONICS

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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 readers. 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 readers to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3 1/2" H x 8 1/2" W x 8 1/2" D.

JE600/DTE-HK (After assembled as pictured above) \$99.95

JE600 Kit (9-Key Hexaded. Keyboard, PC Board & Cmpnts. (no case)) \$59.95

K19 19-Key Keyboard (Keyboard only) \$14.95

DTE-HK (case only - 3 1/2" H x 8 1/2" W x 8 1/2" D) \$44.95

JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and -12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII list. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 16-pin edge connector. Size: 3 1/2" H x 14 1/2" W x 8 1/2" D.

JE610/DTE-AK (After assembled as pictured above) \$124.95

JE610 Kit (62-Key Keyboard, PC Board, & Components (no case)) \$ 79.95

DTE-AK (Keyboard only) \$ 34.95

K62-AK (case only - 3 1/2" H x 14 1/2" W x 8 1/2" D) \$ 49.95

JE212 - Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT. Provides -12VDC from incoming 5VDC. \$9.95

JE215 Adjustable Dual Power Supply

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 B'd. (to JE200) 25, 49 & 12V \$12.95

JE210 Var. Pwr. Spl'y. Kit. 5-15VDC, to 1.5amp. \$19.95

HP-Display Sale-National

5082 Series - 0.43 Inch - 7-Segment

Part Number	Color	Description	1-3 Price	SALE PRICE
5082-7650	HI Eff Red	CA - LHD	99	4 / \$2.49
5082-7651	HI Eff Red	CA - RHD	99	4 / \$2.49
5082-7653	HI Eff Red	CC - RHD	99	4 / \$2.49
5082-7656	HI Eff Red	Overflow ± 1RHD	99	4 / \$2.49
5082-7660	Yellow	CA - LHD	99	4 / \$2.49
5082-7661	Yellow	CA - RHD	99	4 / \$2.49
5082-7663	Yellow	CC - RHD	99	4 / \$2.49
5082-7670	Green	CA - LHD	99	4 / \$2.49
5082-7671	Green	CA - RHD	99	4 / \$2.49
5082-7673	Green	CC - RHD	99	4 / \$2.49
5082-7676	Green	Overflow ± 1RHD	99	4 / \$2.49
5082-7750	Red	CA - LHD	99	4 / \$2.49
5082-7751	Red	CA - RHD	99	4 / \$2.49
5082-7756	Red	Overflow ± 1RHD	99	4 / \$2.49
5082-7760	Red	CC - RHD	99	4 / \$2.49

CA-Comm. Anode CC-Comm. Cathode LHD/RHD Left/right hand dcd.

Mini Stereo AM/FM Receiver

WITH HEADPHONES For Joggers, Cyclists, Skaters & Sports Events

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: 3 1/2" x 4 1/2" x 1". Wt. 6 oz.

Model 2830 \$29.95

KEYBOARDS — POWER SUPPLIES

ALPS 26-KEY CALCULATOR KEYBOARD
Features: 7 Position, 3 Position and 2 Position Switches (ON/OFF). These are from Olivetti's Top of the Line. Mechanical SPST Switching; 22-pin Edge Card Connection.
Part No. KB26 \$1.95 each or 2 / \$3.49

MICRO SWITCH 69-KEY KEYBOARD
Data Entry Keyboard. Encoded Output: 8-bit Parallel EBC DIC. Switching: Hall Effect. 24-pin Edge Card Connection. Complete with Pin Connector.
Part No. KB69SD12-2 (Fits Into DTE-20 Enclosure) \$19.95 each

DATANETICS 74-KEY KEYBOARD
ASCII Encoded Keyboard. Output: Even Parity ASCII. Supply voltage +5, -12 volt. Switching: Mechanical SPST - 50-pin Connector. Complete with Pin Connector.
Part No. KB354 (Fits Into DTE-20 Enclosure) \$29.95 each

MICRO SWITCH 85-KEY KEYBOARD
Word Processing Keyboard. 26 Pin Edge Card Connection. Supply Voltage +5VDC. Main Keyboard is QUERTY. Additional Key Pads for Cursor and word processing functions.
Part No. 85SD18-K \$29.95 each

MICRO SWITCH 88-KEY KEYBOARD (PARALLEL ASCII)
Data Entry Keyboard used in a Diablo 1640 Terminal. Supply Voltage: +5V, -12V. Switching: Hall Effect - 10-pin Edge Card Connection. Schematic Included. Uses 8048 Encoder Chip.
Part No. 88SD22 (Fits Into DTE-20 Enclosure) \$69.95 each

POWER SUPPLY - 5VDC @ 1 AMP REGULATED
Transaction Tech Output +5VDC @ 1 amp (also ±30VDC) reg. input 115VAC 60Hz. Two-tone (black/white) self-enclosed case. 6 H. 3 cond. black power cord. Size: 6 1/2" W x 7" D x 2 1/4" H. Wt. 3 lbs.
Part No. P551194 \$19.95 each

POWER SUPPLY - 5VDC @ 1 AMP REGULATED
8 Industries Output +5VDC @ 1 amp, ±36-42VDC adj. 400mA or less. 30VAC (iso.) @ 1.5 amp. Input 115VAC 60Hz. Cnc. brkr. re-set button. Blk. self-enc. case w/4 rubber feet. 6 H. 3 cond. blk. pow. cord. On/off switch. 5 1/2" W x 7 1/4" D x 3-7/8" H. wt. 7 lbs.
Part No. P54070 \$24.95 each

POWER SUPPLY - 5VDC @ 7.5 AMP, 12VDC @ 1.5 AMP SWITCHING
Input: 115VAC, 50-60Hz @ 2A. 12VDC @ 4A & ±24VDC @ 3A. Input: 115VAC, 7A, 230VAC, 5.5 amp. 15% line & load cond. Ripple: 10mV peak to peak (DVR RMS). Overvolt. protect. 5V, ±12V, -12V. Overvoltage. Input: 5A @ 6" H x 6" H x 11-7/8" D. Wt. 40 lbs.
Part No. P594VD \$49.95 each

POWER PAC - Heavy Duty Multi-Voltage Power Supply - 5VDC, 12VDC, 24VDC
Output: +5VDC @ 1 amp, +12VDC @ 2A, -12VDC @ 4A & ±24VDC @ 3A. Input: 115VAC, 7A, 230VAC, 5.5 amp. 15% line & load cond. Ripple: 10mV peak to peak (DVR RMS). Overvolt. protect. 5V, ±12V, -12V. Overvoltage. Input: 5A @ 6" H x 6" H x 11-7/8" D. Wt. 40 lbs.
Part No. 285-016 \$89.95 each

SORENSEN Regulated Power Supplies

Sorenson's open construction (SOC) power supplies are series-regulated solid-state systems, designed to provide reg. DC voltages at 6 levels (2-28 v/range). These units are open-framed on sturdy black anodized aluminum for excellent mounting.

FEATURES: 115V/208/230VAC input @ 50/60Hz. Low Ripple: 1.5mVrms. 5mV P-P maximum. Adjustable current limit. Voltage adjustment control. All schematics and specifications supplied with unit. Series A, B, C, E have three mounting surfaces (Series F, bottom mounting only).

Part No.	Series	Output Voltage Adjustment Range	Output Current (Amps)	Size (Inches)	Weight	Price
SOC-2-6	B	1.9 - 2.1	6.0	4.9	3.8	\$82 x 4.88 x 2.50 4.3 lbs. \$19.95
SOC-2-6	F	1.9 - 2.1	25.0	21.5	17.5	15.00 x 4.88 x 4.88 16 lbs. 29.95
SOC-3-3	A	4.75 - 5.25	3.0	2.4	1.2	4.00 x 4.00 x 1.82 2 lbs. 24.95
SOC-3-3	E	4.25 - 5.25	18.0	15.0	12.0	14.00 x 4.88 x 2.75 12 lbs. 26.95
SOC-3-3	F	4.25 - 5.25	28.0	21.5	17.5	16.00 x 4.88 x 4.88 16 lbs. 49.95
SOC-12-18	E	11.4 - 12.6	11.0	9.2	6.8	14.00 x 4.88 x 1.82 12 lbs. 44.95
SOC-12-18	F	11.4 - 12.6	15.0	12.5	9.5	16.00 x 4.88 x 4.88 16 lbs. 48.95
SOC-15-5	C	14.25 - 15.75	5.0	4.2	3.6	7.00 x 4.88 x 3.37 6.6 lbs. 39.95
SOC-15-5	F	14.25 - 15.75	15.0	12.5	7.8	14.00 x 4.88 x 1.82 12 lbs. 44.95
SOC-15-5	F	14.25 - 15.75	13.0	10.5	8.0	16.00 x 4.88 x 4.88 16 lbs. 48.95
SOC-28-0-3	A	26.5 - 28.4	0.8	6.4	4.5	4.00 x 4.88 x 1.82 2 lbs. 24.95

Powertec Sub-Modular DC Power Supplies

SM Series power supplies include rectifying, filtering, regulating, overload and overvoltage protection functions. You need only connect the sub-module to the appropriate secondary transformer tap and bolt the unit to a heatsink.

REGULATION: LINE: 10% for a change from -10% to +10% input voltage. LOAD: 15% for 0-100% load change (units below 10V output maintain 5% regulation). OUTPUT RIPPLE: 1mV RMS, 3mV P-P typical. 5mV P-P maximum. INPUT CHARACTERISTICS: Requires low-level AC input. Derate output current 15% for operations at 50Hz.

Part No.	Series	Output Voltage	Output Current	Size (Inches)	Weight	Price
22A-300		115-120VAC	17VAC 5A or CT	2.50 x 3.00 x .90	7 oz.	\$14.95
22B-200		115-120VAC	22VAC 3A w/CT	3.00 x 3.75 x 1.18	8 oz.	14.95
22B-300		115-120VAC	28VAC 2.5A w/CT	2.75 x 3.75 x 1.18	8 oz.	19.95
22C-100	8.0A	115-120VAC	16VAC 8A w/CT	2.80 x 7.50 x 1.18	8 oz.	24.95
22C-500		115-120VAC	48VAC 3A w/CT	2.80 x 7.50 x 1.18	8 oz.	24.95
22D-300		115-120VAC	28VAC 10A w/CT	3.00 x 7.00 x 3.30	2 lbs.	24.95
22E-100	18.00A	115-120VAC	16VAC 24A w/CT	2.90 x 7.00 x 3.30	2 lbs.	29.95

*Voltage Adjustment Range - Current ratings apply over entire voltage range.

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All jumpers use low profile dip plugs with heavy duty pins for repeated disconnect applications.

JAMECO Part No.	Alt. Cross-Reference	No. Pins	Length	Price
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D040-2	924132 24	40	single end 24"	6.78
D040-3	924132 36	40	single end 36"	7.69
D040-140	924136 12	40	double end 12"	10.95
D040-240	924136 24	40	double end 24"	11.89
D040-340	924136 36	40	double end 36"	12.79

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Now you can order DB25 P or S connectors with the cable necessary to fit your application. Choose from our standard flat cable in 4-foot lengths. Call today.

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DB25P-4 P	4 feet	2 DB25P	16.95 ea.
DB25P-4 S	4 feet	1 DB25P/1 DB25S	17.95 ea.
DB25S-4 S	4 feet	2 DB25S	16.95 ea.

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Part No. Limited Quantity! Price
FD200 \$179.95
Single-sided, 40 tracks, 250K bytes capacity
FD250 \$199.95
Double-sided, 35 tracks, 438K bytes capacity

EXPAND YOUR TRS-80

to 16K, 32K, or 48K

**Model 1 = From 4K to 16K Requires (1) One Kit
Model 3 = From 4K to 48K Requires (3) Three Kits
Color = From 4K to 16K Requires (1) One Kit

**Model 1 equipped with Expansion Board up to 48K Two Kits Required - One Kit Required for each 16K of Expansion -

TRS-80 16K Conversion Kit

Kit comes complete with 8 each MM5290 (UPD4161/4116) 16K Dynamic RAM (*ns) and documentation for conversion.

TRS-16K2 *150ns \$16.95
TRS-16K3 *200ns \$14.95
TRS-16K4 *250ns \$10.95

TRS-80 Color 32K Conversion Kit

Kit comes complete with 8 ea. 4164-2 (200ns). 64K Dyn. RAMs & conversion documentation. Converts TRS-80 color computers with F-Revision Boards from 16K to 32K.

TRS-64K2 (200ns) \$69.95

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DTE's Blank Desk Top Enclosures are designed for easy modification. High strength epoxy molded end pieces in motta brown finish. Shingling bottom panel for service/component access. Top/foot panels (DTE) thick alum. anodize type 1200 finish (gold tint color) for best paint adhesion after modification. Vented top & bottom panels for cooling efficiency.

DTE-20 Panel width 20" \$39.95

Pee Wee Boxer Fan

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3.125" sq. x 1.665" depth
10 yrs. cont. duty at 20°C
115V 50/60Hz
For Apple users

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JS-5K 5K Linear Taper Pots \$5.25
JS-100K 100K Linear Taper Pots \$4.95
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JVC-40 40K (2) Video Controller in Case \$4.95

UV-EPROM Eraser

8 Chips - 51 Minutes
1 Chip - 37 Minutes

Erases 2708, 2716, 2732, 2765, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 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 9.00" x 3.70" x 2.60". Complete with holding tray for chips.

UVS-11EL Replacement Bulb

DE-4 UV-EPROM Eraser \$79.95

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Part No.	Input	Output	Price
AC 750 (above)	117V/60Hz	12VAC 250mA	\$3.95
AC 1000	117V/60Hz	12VAC 500mA	\$4.95
AC 1500	117V/60Hz	12VAC 1 amp	\$5.95
AC 2000	117V/60Hz	9VAC 1 amp	\$3.95
AC9004	117V/60Hz	9VDC 2.5 amp	\$2.95 or 234.95
DC 800	120V/60Hz	5VDC 400mA	\$1.95 or 232.95
DC6912	120V/60Hz	6.5V 200C 300mA	\$9.95
DV5490	117V/60Hz	9VDC 275mA	\$2.49 or 233.95
DC9300	120V/60Hz	5VDC 500mA	\$3.95
DC1200	120V/60Hz	12VDC 300mA	\$2.95 or 234.95

MOTOROLA AM/FM Stereo Push Button Car Radio

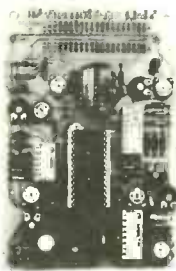
FOR VOLKSWAGEN SCIROCCO, RABBIT, AUDI 5000 and FOX (with minor adjustments, can be used in any automobile). Includes bezel trim & everything pictured. Two ea. 4.6 speakers & grille (1 1/2" deep). All cables & leads for hook-up incl. all instruction Manuals for easy installation. Cut-out dim: 7" W x 1 1/4" H x 6 1/2" L.

Model 5VW3901 \$49.95

BEC BULLET ELECTRONICS

P.O. BOX 401244R GARLAND, TX. 75040 (214) 278-3553

Sound Effects Kit \$18.50

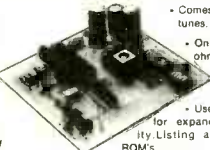


The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new Texas Instruments SN76477 Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3" x 5" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate Explosions, Phasor Guns, Steam Trains, or almost an infinite number of other sounds. The unit has a multiple of applications. The low price includes all parts, assembly manual, programming charts and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100mW amp will drive a small speaker directly or the unit can be connected to your stereo with incredible results! (Speaker not included) 76477 is included. Available separately for \$3.15 each.

The Super Music Maker

REVISION 2
\$24.95
(Basic Kit)

SEE SPECIAL OFFER BELOW



- Comes with 25 pre-programmed tunes.
- On board 7 watt amplifier drives 8 ohm speaker directly.
- Works on 12VAC or 12 VDC.
- Uses either 2708 or 2716 EPROM for expanded tune playing capability. Listing available pre-programmed ROMs.

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OPTIONAL ACCESSORIES

- DIP SWITCHES One 8 pos., one 5 pos., for tune address 2.00/set
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- HORN SPEAKER 8 watt, 8 Ohm with mounting bracket 6.25

SPECIAL OFFER

Buy a Super Music Maker kit for \$24.95 and get FREE, a 2708 ROM pre-programmed with 35 popular tunes. This offer gives you over 50 songs to choose from!

7 Watt Audio Amp Kit \$6.95

SMALL, SINGLE HYBRID IC and COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT.

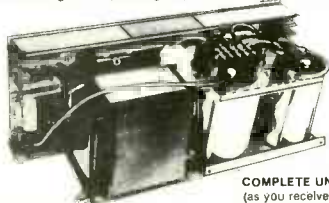
Doomsday Alarm Kit \$9.95

If you have trouble sleeping and you would like the rest of the neighborhood to share your misery then this little kit will be for you! There is no way to accurately describe the unearthly howls, screams and tones that come out of this kit. Four separate tone oscillators are mixed, cancelled and stepped at a varying rate. 10 Watts of crazy sounds. A great fun kit or a practical burglar alarm. Complete with PC board and all necessary components less speaker. For 6-12 VDC. ORDER DA-02

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After taking one look at the TRIPUT POWER SUPPLY our engineer declared that the units were worth several hundred dollars each. He pointed out the engineering, high quality construction and state-of-the-art integrated design in support of his position. The President of BEC more pragmatically pointed out the already full warehouse and the two trailer truck loads of power supplies waiting in the parking lot, and set the price to move them QUICKLY!

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- 12V @ 8A (12A Int.)
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Universal Counter counts up to 60 MHz and 10 million events. 7 large 0.5" digits. Crystal time base. High performance. Assm \$24.50 HKIT-83A Kit \$19.50

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3.2768	3.90	18.0	3.00
3.579545	3.00	18.432	3.00
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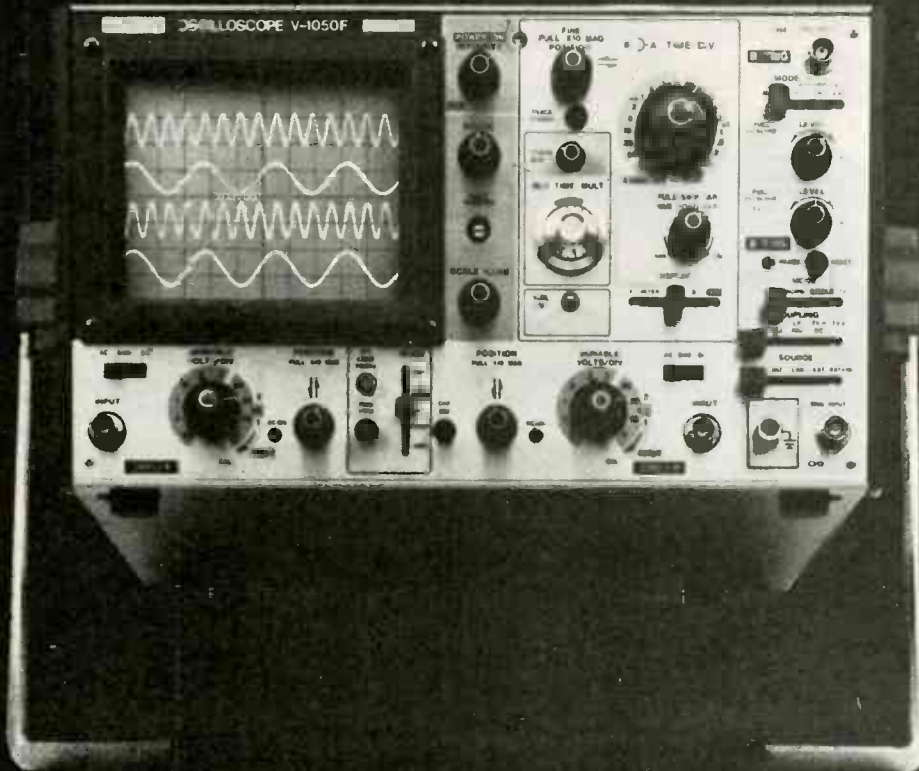


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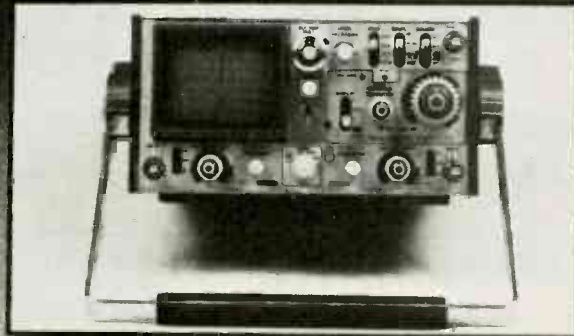
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**V-509 Delayed Sweep DC-50 VHz
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FEATURES: • 3.5" Rectangular CRT • Sensitivity 1 mV/div. (10 MHz) • Sweep Times to 10 ns/div. • Individual Sweep Time Controls (A, B) • Full TV Triggering (H, V) • CH 1 Signal DVM Output • Single Sweep • Variable Hold-off • X-Y Display Mode • Three Way Power Supply • Optional Battery Pack Available



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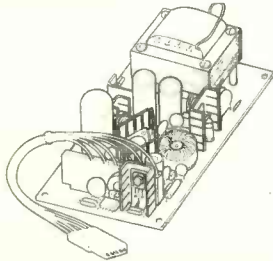


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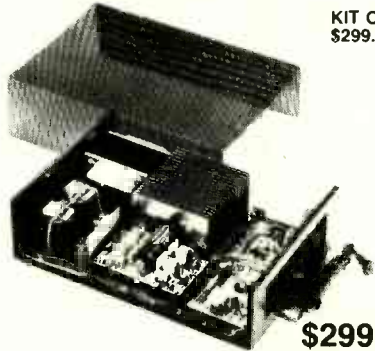
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Model A502 DC Stereo Control Center

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 - MC = 16mv RMS (1KHz)
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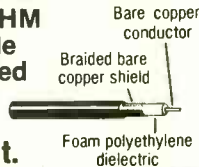
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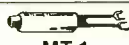
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Matching Transformer
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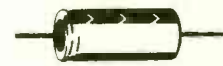


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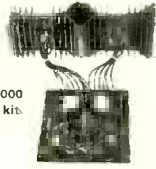


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- S/N better than 100dB
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MODEL TA-2000 \$83.95 per kit

PROFESSIONAL FM WIRELESS MICROPHONE

Made by one of the leading Japanese manufacturers. This factory assembled FM wireless microphone is powered by two AA size batteries. It transmits in the range of 88-108 MHz. Element is built in a plastic tube type case with an omni-directional electronic 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." by the MODEL WEM-36.

ON SALE \$12.50 each



7 WATTS

100 WATTS

HYBRID AUDIO POWER AMPLIFIER IC'S From 7 WATTS to 100 WATTS

Typical ratings: Operating case temp. 85°C. T.H.D. = 0.5% @ 20Hz-20KHz. Input resistance Po=0.1W/30KΩ. Power band width 20Hz-20KHz. Freq. response 10-100KHz. Output resistance = 8Ω. With built-in protection circuit. All units come with data sheet.

Part No.	Output	Vcc	Unit Price
STK040	10W+10W	±16V	\$14.50
STK041	15W+15W	±20V	\$18.50
STK050	50W	±35V	\$26.50
STK054	23W	±19V	\$13.50
STK056	30W	±22V	\$18.50
STK070	70W	±42V	\$32.50
STK415	7W+7W	30V	\$ 8.50
STK439	15W+15W	39V	\$18.50
STK465	30W+30W	±28V	\$25.50
STK0105	100W	±50V	\$36.50

SANYO ANTENNA SIGNAL BOOSTER

This Booster is specially designed for UHF Channels (14-83). After installing (between the antenna input cable and the UHF tuner), this unit will provide a minimum of 10dB gain, that is approximately 2 times better than you are seeing now. Ideal for those who live in apartments that can not put up an outdoor antenna. Small in size, only 2" x 1 1/2" x 1". Supply voltage is 15 VDC. Back In Stock.



★ NEW ITEM ★
MODEL 001-0076
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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 and if you whistle again, it will turn off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, TV, Hi-Fi, radio or other projects. Unit works on 9VDC.

MODEL 968 \$4.50 ea.

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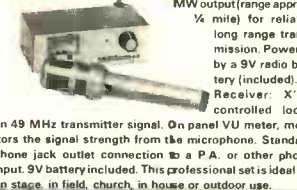
MC1358	\$3.00 ea.	LM380	\$2.00 ea.
MC1350	\$2.25 ea.	LM7815	1.20 ea.
MC1330	\$3.00 ea.	LM7818	1.20 ea.
MC1496	\$2.50 ea.	10K 10T PC Mount	3.00 ea.
LM1458	\$1.00 ea.	10K 1T PC Mount	1.75 ea.
LM1889	\$3.75 ea.	Torroid Coils (set of 4)	3.00 ea.
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on 49 MHz transmitter signal. 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.

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Tuning voltage +1+28VDC. Input impedance 75Ω. IF band width 7-16MHz. Noise figure 11.5dB Max. Size 2 1/2" x 1 1/2" x 3/4". Supply voltage 15VDC. Sound IF=58.0MHz.
Model 115-B-403A, Video IF 62.5MHz
Model 115-B-405A, Video IF 45.0MHz
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Tuner is the most important part of the circuit. Don't let those \$19.00 brands fool you. All units are brand new from Sanyo. When ordering please specify model number.

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All solid state circuitry with high efficiency power transistor 2SD388 and IC voltage regulator MC1733. Output voltage can be adjusted from 0-30V at 1A current limited or 0-15V at 2A current limited. Internal resistance is less than 0.005Ω, ripple and noise less than 1mV, dual on panel meters for voltage and amp reading, also with on board LED and audible overload indicator. Kit comes with pre-drilled PC Board, instructions, all necessary electronic components, transformer and a professional looking metal cabinet. The best project for school and the most useful instrument for repairmen. Build one today!



MODEL TR88A
0-15VDC @ 2A
MODEL TR88B
0-30VDC @ 1A
\$59.50 Per Kit

SUPER FM WIRELESS MIC KIT — MARK III

This new designed circuit uses high FREQ FET transistors with 2 stage pre-amp. Transmits FM range (88-120MHz) up to 2 blocks away and with the ultra sensitive condenser 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 PC Board. Power supply 9VDC.
FMC-105
\$11.50 Per Kit

FLORESCENT AUDIO LEVEL MONITOR

This is the kind of VU monitor that is being used by most amplifier manufacturers. IC's are used to simplify circuit layout. Easy to assemble and can be used with all power level amplifiers. Power requirement 12VDC.



TE-221 KIT
For Just \$28.50 (Limited Stock)

REGULATED DUAL VOLTAGE SUPPLY KIT ±10-30 VDC @ 250 ma adjustable, fully regulated. Kit includes all electronic parts, filter capacitors, IC's, heat sinks and PC Board.

\$12.50 per kit

MARK IV — 15 STEP

LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED's (15 per channel) to indicate the sound level output of your amplifier from -36dB to +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 6-12VDC 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's, all other electronic components, PC Board and front panel.

MARK IV KIT \$31.50



ELECTRONIC SWITCH KIT

CONDENSER TYPE. Touch On - Touch Off. Uses 7473 IC and 12V relay \$5.50

POWER SUPPLY KIT

0-30VDC REGULATED. Uses UA723 and 2N3055 power transistor. Output can be adjusted from 0-30V @ 2A. Complete with PC Board and all electronic parts.

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POWER SUPPLY KIT \$10.50 ea.

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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.
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A GOOD BUY at \$65.00

TA-800

AUDIO FREQUENCY SPECTRUM ANALYSER KIT TA-2900

This Audio Frequency Spectrum Analyser analyses audio signals in 10 octaves over a dynamic range of 30dB. The technique allows the sound coloration introduced by unwanted room and speaker resonances to be substantially eliminated. The TA-2900 provides a visual presentation of the changing spectrum thru 100 red LED displays, so you can actually see proof of the equalized sound you've achieved. The TA-2900 kit comes with all the electronic components, IC's, predrilled PC board, the instructions and a 19" Rack Mount type metal cabinet with professional silk screen printed front panel.

- Input Sensitivity Tape Monitor/10mV - 18mV 50K Ω. Speaker Terminal/0.2W - 100W 8Ω
- Display Level Range (all octaves) 2dB per step/-14dB to -4dB.
- Delay Time (1KHz) Fast/18dB/s Slow/6dB/s
- Power Input 117V or 220V AC 50/60 Hz.
- Power Consumption 36W.
- Dimensions 482(W) x 102(H) x 250(D) mm.

\$99.50 per kit



LOW TIM DC STEREO PRE-AMP KIT TA-1020

Incorporates brand-new DC design that gives a frequency response from 0-100KHz ±0.5dB. Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation! Specifications: • THD/TIM 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 controls Bass ±10dB @ 50Hz Treble ±10dB @ 15Hz • Power supply ±24VDC @ 0.5A. Kit comes with regulated power supply, all you need is a 48VCT transformer @ 0.5A. Only \$44.50



"FISHER" 30 WATT STEREO AMP

MAIN AMP (15W x 2). Kit Includes 2 pcs. Fisher PA 301 Hybrid IC, all electronic parts with PC Board. Power supply ±16VDC (not included). Power band with KF 1%+3dB. Voltage gain 33dB. 20Hz-20KHz.
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\$15.50 ea.



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TA-1000 KIT \$51.95
Power Transformer \$24.00 ea.

TA-323 60 WATTS TOTAL 30W + 30W STEREO AMP KIT

This is a solid state all transistor circuitry with on board stereo pre-amp for most microphones or phone input. Power output employs 2 pairs matching Darlingtons Transistors driven by the popular 2N3053 Driver Transistors. Four built on board controls for, volume, balance, treble and bass. Power supply requires 48VCT 2.5A transformer. THD of less than 0.1% between 100Hz - 0KHz at full power. (30 Watts + 30 Watts loaded into 8Ω).

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SPECIAL PRICE \$1.95

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TMS4044-2	4096 x 1 (200ns)	4.49
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HM6116-3	2048 x 8 (150ns) (cmos)	7.10
HM6116-2	2048 x 8 (120ns) (cmos)	9.95
HM6116LP-4	2048 x 8 (200ns) (cmos)(LP)	8.75
HM6116LP-3	2048 x 8 (150ns) (cmos)(LP)	8.95
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5V = single 5 volt supply

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2732	4096 x 8 (450ns) (5v)	6.95
2732-250	4096 x 8 (250ns) (5v)	12.95
2732-200	4096 x 8 (200ns) (5v)	16.95
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2764-250	8192 x 8 (250ns) (5v)	18.95
2764-200	8192 x 8 (200ns) (5v)	19.95
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MC68764	8192 x 8 (450ns) (5v)(24 pin)	call

5v = Single 5 Volt Supply

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PE-24T	X	9	6,700	175.00
PL-265T	X	20	6,700	255.00
PR-125T	X	16	15,000	349.00
PR-320	X	32	15,000	595.00

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1791	29.95
1793	38.95
1795	54.95
1797	54.95
6843	34.95
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8T26	1.69
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MC3470	4.95
MC3480	9.00
11C90	13.95
95H90	7.95
2513-001 UP	9.95
2513-002 LOW	9.95

SOUND CHIPS

76477	3.95
76489	8.95
AY3-8910	12.95
MC3340	1.49

CRT CONTROLLERS

6845	14.95
68B45	35.95
HD46505SP	15.95
6847	12.25
68047	24.95
8275	29.95
7220	99.95
CRT5027	39.95
CRT5037	49.95
TMS9918A	39.95

BIT-RATE GENERATORS

MC14411	11.95
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4702	12.95
COM5016	16.95
COM8116	10.95
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UARTS

AY3-1014	6.95
AY5-1013	3.95
PT1472	9.95
TR1602	3.95
2350	9.95
2651	18.95
TMS6011	5.95
IM6402	7.95
IM6403	8.95
INS8250	14.95

KEYBOARD CHIPS

AY5-2376	11.95
AY5-3600	11.95
74C922	5.25
74C923	5.50

CLOCK CIRCUITS

MM5314	4.95
MM5369	3.95
MM5375	4.95
MM58167	8.95
MM58174	11.95
MSM5832	6.95

Z-80 2.5 Mhz

Z80-CPU	3.95
Z80-CTC	5.95
Z80-DART	15.25
Z80-DMA	17.50
Z80-PIO	5.75
Z80-SIO/0	18.50
Z80-SIO/1	18.50
Z80-SIO/2	18.50
Z80-SIO/9	16.95

4.0 Mhz

Z80A-CPU	6.00
Z80A-CTC	8.65
Z80A-DART	18.75
Z80A-DMA	27.50
Z80A-PIO	6.00
Z80A-SIO/0	22.50
Z80A-SIO/1	22.50
Z80A-SIO/2	22.50
Z80A-SIO/9	19.95

6.0 Mhz

Z80B-CPU	17.95
Z80B-CTC	15.50
Z80B-PIO	15.50

ZILOG

Z6132	34.95
Z8671	39.95

CRYSTALS

32.768 khz	1.95
1.0 mhz	4.95
1.8432	4.95
2.0	3.95
2.097152	3.95
2.4576	3.95
3.2768	3.95
3.579535	3.95
4.0	3.95
5.0	3.95
5.0688	3.95
5.185	3.95
5.7143	3.95
6.0	3.95
6.144	3.95
6.5536	3.95
8.0	3.95
10.0	3.95
14.31818	3.95
15.0	3.95
16.0	3.95
18.0	3.95
18.432	3.95
20.0	3.95
22.1184	3.95
32.0	3.95

DATA ACQUISITION

ADC0800	15.55
ADC0804	4.95
ADC0809	5.25
ADC0817	10.95
DAC0800	4.95
DAC0806	2.25
DAC0808	4.95
DAC1020	8.25
DAC1022	8.25
MC1408L6	2.25
MC1408L8	4.95

8000

8035	7.25
8039	7.95
INS-8060	17.95
INS-8073	29.95
8080	3.95
8085	7.95
8085A-2	11.95
8086	29.95
8087	CALL
8088	39.95
8089	89.95
8155	7.95
8156	8.95
8185	29.95
8185-2	39.95
8741	39.95
8748	29.95
8755	32.00

8200

8202	29.95
8203	39.95
8205	3.50
8212	1.85
8214	3.85
8216	1.80
8224	2.50
8226	1.80
8228	4.90
8237	19.95
8238	4.95
8243	4.45
8250	14.95
8251	4.75
8253	9.25
8253-5	9.85
8255	4.75
8255-5	5.25
8257	8.50
8257-5	8.95
8259	6.90
8259-5	7.50
8271	39.95
8272	39.95
8275	29.95
8279	9.50
8279-5	10.00
8282	6.65
8283	6.65
8284	5.70
8286	6.65
8287	6.50
8288	25.00
8289	49.95

6800

68000	99.95
6800	4.95
6802	10.95
6808	13.90
6809E	19.95
6809	12.95
6810	2.95
6820	4.95
6821	4.95
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	14.95
6847	12.25
6850	3.45
6852	5.75
6860	10.95
6862	11.95
6875	6.95
6880	2.95
6883	24.95
68047	24.95
68488	19.95

6800 - 1MHZ

68B00	10.95
68B02	22.25
68B09E	29.95
68B09	29.95
68B10	7.95
68B21	12.95
68B45	35.95
68B50	12.95

6500 1 MHZ

6502	5.95
6504	6.95
6505	8.95
6507	9.95
6520	4.35
6522	8.75
6532	11.25
6545	22.50
6551	11.85

2 MHZ

6502A	9.95
6522A	11.70
6532A	12.40
6545A	28.50
6551A	12.95

3 MHZ

6502B	14.95
-------	-------

FUNCTION GENERATORS

MC4024	3.95
LM566	1.49
XR2206	3.75
8038	3.95

EXAR

XR 2206	3.75
XR 2207	3.85
XR 2208	3.90
XR 2211	5.25
XR 2240	3.25

INTERSIL

ICL7103	9.50
ICL7106	9.95
ICL7107	12.95
ICL8038	3.95
ICM7107A	5.59
ICM7208	15.95

9000 SERIES

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9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
96S02	1.95

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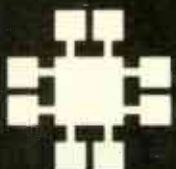
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74LS00

74LS00	.25	74LS86	.40	74LS169	1.75	74LS323	2.75
74LS01	.25	74LS90	.65	74LS170	1.75	74LS324	1.75
74LS02	.25	74LS91	.89	74LS173	.80	74LS352	1.55
74LS03	.25	74LS92	.70	74LS174	.95	74LS353	1.55
74LS04	.25	74LS93	.65	74LS175	.95	74LS363	1.35
74LS05	.25	74LS95	.85	74LS181	2.15	74LS364	1.95
74LS08	.35	74LS96	.95	74LS189	9.95	74LS365	.95
74LS09	.35	74LS107	.40	74LS190	1.00	74LS366	.95
74LS10	.25	74LS109	.40	74LS191	1.00	74LS367	.70
74LS11	.35	74LS112	.45	74LS192	.85	74LS368	.70
74LS12	.35	74LS113	.45	74LS193	.95	74LS373	1.75
74LS13	.45	74LS114	.50	74LS194	1.00	74LS374	1.75
74LS14	1.00	74LS122	.45	74LS195	.95	74LS377	1.45
74LS15	.35	74LS123	.95	74LS196	.85	74LS378	1.18
74LS20	.25	74LS124	2.99	74LS197	.85	74LS379	1.35
74LS21	.35	74LS125	.95	74LS221	1.20	74LS385	1.90
74LS22	.25	74LS126	.85	74LS240	1.29	74LS386	.65
74LS26	.35	74LS132	.75	74LS241	1.29	74LS390	1.90
74LS27	.35	74LS133	.89	74LS242	1.85	74LS393	1.90
74LS28	.35	74LS136	.55	74LS243	1.85	74LS395	1.65
74LS30	.25	74LS137	.99	74LS244	1.29	74LS399	1.70
74LS32	.35	74LS138	.75	74LS245	1.90	74LS424	2.95
74LS33	.55	74LS139	.75	74LS247	.75	74LS447	.37
74LS37	.55	74LS145	1.20	74LS248	1.25	74LS490	1.95
74LS38	.35	74LS147	2.49	74LS249	.99	74LS624	3.99
74LS40	.35	74LS148	1.35	74LS251	1.30	74LS668	1.69
74LS42	.55	74LS151	.75	74LS253	.85	74LS669	1.89
74LS47	.75	74LS153	.75	74LS257	.85	74LS670	2.20
74LS48	.75	74LS154	2.35	74LS258	.85	74LS674	9.65
74LS49	.75	74LS155	1.15	74LS259	2.85	74LS682	3.20
74LS51	.25	74LS156	.95	74LS260	.65	74LS683	3.20
74LS54	.35	74LS157	.75	74LS266	.55	74LS684	3.20
74LS55	.35	74LS158	.75	74LS273	1.65	74LS685	3.20
74LS56	1.25	74LS160	.90	74LS275	3.35	74LS688	2.40
74LS73	.40	74LS161	.95	74LS279	.55	74LS689	3.20
74LS74	.45	74LS162	.95	74LS280	1.98	74LS783	24.95
74LS75	.50	74LS163	.95	74LS283	1.00	81LS95	1.69
74LS76	.40	74LS164	.95	74LS290	1.25	81LS96	1.69
74LS78	.50	74LS165	.95	74LS293	1.85	81LS97	1.69
74LS83	.75	74LS166	2.40	74LS295	1.05	81LS98	1.69
74LS85	1.15	74LS168	1.75	74LS298	1.20	25LS2521	2.80
						25LS2569	4.25

IC SOCKETS

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 - SOLDER TAIL		
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		
16 pin ZIF	6.75	call
24 pin ZIF	9.95	call
ZIF - TEXT TOOL (Zero Insertion Force)		

7400

7400	.19	74132	.45
7401	.19	74136	.50
7402	.19	74141	.65
7403	.19	74142	2.95
7404	.19	74143	2.95
7405	.25	74145	.60
7406	.29	74147	1.75
7407	.29	74148	1.20
7408	.24	74150	1.35
7409	.19	74151	.65
7410	.19	74152	.65
7411	.25	74153	.55
7412	.30	74154	1.40
7413	.35	74155	.75
7414	.55	74156	.65
7416	.25	74157	.55
7417	.25	74159	1.65
7420	.19	74160	.85
7421	.35	74161	.70
7422	.29	74162	.85
7423	.29	74163	.85
7425	.29	74164	.85
7426	.29	74165	.85
7427	.29	74166	1.00
7428	.45	74167	2.95
7430	.19	74170	1.65
7432	.29	74172	5.95
7433	.45	74173	.75
7437	.29	74174	.89
7438	.29	74175	.89
7440	.19	74176	.89
7442	.49	74177	.75
7443	.65	74178	1.15
7444	.69	74179	1.75
7445	.69	74180	.75
7446	.59	74181	2.25
7447	.69	74182	.75
7448	.69	74184	2.00
7450	.19	74185	2.00
7451	.23	74186	18.50
7453	.23	74190	1.15
7454	.23	74191	1.15
7460	.23	74192	.79
7470	.35	74193	.79
7472	.29	74194	.85
7473	.34	74195	.85
7474	.35	74196	.79
7475	.49	74197	.75
7476	.35	74198	1.35
7480	.59	74199	1.35
7481	1.10	74221	1.35
7482	.95	74246	1.35
7483	.50	74247	1.25
7485	.65	74248	1.85
7486	.35	74249	1.95
7489	4.95	74251	.75
7490	.35	74259	2.25
7491	.40	74265	1.35
7492	.50	74273	1.95
7493	.49	74276	1.25
7494	.65	74279	.75
7495	.55	74283	2.00
7496	.70	74284	3.75
7497	2.75	74285	3.75
74100	1.75	74290	.95
74107	.30	74293	.75
74109	.45	74298	.85
74110	.45	74351	2.25
74111	.55	74365	.65
74116	1.55	74366	.65
74120	1.20	74367	.65
74121	.29	74368	.65
74122	.45	74376	2.20
74123	.55	74390	1.75
74125	.45	74393	1.35
74126	.45	74425	3.15
74128	.55	74426	.85
		74490	2.55

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 FEMALE	3.75
RIGHT ANGLE	5.25
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

DIP SWITCHES

4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95

CMOS

4000	.35	4528	1.25
4001	.35	4531	.95
4002	.25	4532	1.95
4006	.95	4538	1.95
4007	.29	4539	1.95
4008	.95	4543	2.70
4009	.45	4555	.95
4010	.45	4556	.95
4011	.35	4581	1.95
4012	.25	4582	1.95
4013	.45	4584	.95
4014	.95	4585	.95
4015	.95	4702	12.95
4016	.45	74C00	.35
4017	1.15	74C02	.35
4018	.95	74C04	.35
4019	.45	74C08	.35
4020	.95	74C10	.35
4021	.95	74C14	1.50
4022	1.15	74C20	.35
4023	.35	74C30	.35
4024	.75	74C32	.50
4025	.35	74C42	1.75
4026	1.65	74C48	1.20
4027	.65	74C73	.65
4028	.90	74C74	.85
4029	.95	74C76	.80
4030	.45	74C83	1.95
4034	2.95	74C85	1.95
4035	.85	74C86	.95
4040	.95	74C89	4.50
4041	1.25	74C90	1.75
4042	.75	74C93	1.75
4043	.85	74C95	1.75
4044	.85	74C107	1.00
4046	.95	74C150	5.75
4047	.95	74C151	2.25
4049	.55	74C154	3.25
4050	.55	74C157	1.75
4051	.95	74C160	2.00
4053	.95	74C161	2.00
4060	1.45	74C162	2.00
4066	.75	74C163	2.00
4068	.40	74C164	2.00
4069	.35	74C165	2.00
4070	.35	74C173	2.00
4071	.30	74C174	2.25
4072	.30	74C175	2.25
4073	.30	74C192	2.25
4075	.30	74C193	2.25
4076	.95	74C195	2.25
4078	.30	74C200	5.75
4081	.30	74C221	2.25
4082	.30	74C373	2.75
4085	.95	74C374	2.75
4086	.95	74C901	.80
4093	.95	74C902	.85
4098	2.49	74C903	.85
4099	1.95	74C905	10.95
14409	12.95	74C906	.95
14410	12.95	74C907	1.00
14411	11.95	74C908	2.00
14412	12.95	74C909	2.75
14419	4.95	74C910	9.95
4502	.95	74C911	10.00
4503	.65	74C912	10.00
4508	1.95	74C914	1.95
4510	.95	74C915	2.00
4511	.95	74C918	2.75
4512	.95	74C920	17.95
4514	1.25	74C921	15.95
4515	2.25	74C922	5.59
4516	1.55	74C923	5.95
4518	1.25	74C925	6.75
4519	1.25	74C926	7.95
4520	1.25	74C927	7.95
4522	1.25	74C928	7.95
4526	1.25	74C929	19.95
4527	1.95	74C930	19.95

**Prices Slashed!
74S00**

74S00	.32	74S163	1.95
74S02	.35	74S168	3.95
74S03	.35	74S169	3.95
74S04	.35	74S174	1.09
74S05	.35	74S175	1.09
74S08	.35	74S181	3.95
74S09	.40	74S182	2.95
74S10	.35	74S188	1.95
74S11	.35	74S189	6.95
74S15	.35	74S194	1.49
74S20	.35	74S195	1.49
74S22	.35	74S196	1.49
74S30	.35	74S197	1.49
74S32	.40	74S201	6.95
74S37	.88	74S225	7.95
74S38	.85	74S240	2.20
74S40	.35	74S241	2.20
74S51	.35	74S244	2.20
74S64	.40	74S251	.95
74S65	.40	74S253	.95
74S74	.50	74S257	.95
74S85	1.99	74S258	.95
74S86	.50	74S260	.79
74S112	.50	74S274	19.95
74S113	.50	74S275	19.95
74S114	.55	74S280	

FLOPPY DISK DRIVE

LINEAR

LM301	.34	LM350K	5.60	NE570	4.75	LM1800	2.99
LM301H	.79	LM350T	4.60	NE571	3.95	LM1812	8.25
LM307	.45	LM358	.98	NE592	2.75	LM1815	5.20
LM308	.98	LM359	1.79	LM703	.89	LM1818	2.90
LM308H	1.15	LM376	3.75	LM709	.59	LM1820	3.50
LM309H	1.95	LM377	2.29	LM710	.75	LM1830	3.50
LM309K	1.49	LM378	2.50	LM711	.79	LM1871	5.49
LM310	1.75	LM379	4.50	LM723	.49	LM1872	5.49
LM311	.64	LM380	1.29	LM723H	.55	LM1877	3.25
LM311H	.89	LM380N-8	1.10	LM733	.98	LM1889	2.49
LM312H	1.75	LM381	1.60	LM741N-8	.35	LM1896	1.75
LM317K	3.95	LM382	1.60	LM741N-14	.35	LM2877	2.05
LM317T	1.95	LM383	1.95	LM741H	.40	LM2878	2.25
LM318	1.49	LM384	1.95	LM747	.79	LM2900	.85
LM318H	1.59	LM386	1.50	LM748	.59	LM2901	1.00
LM319H	1.25	LM387	1.40	LM1014	2.75	LM3900	.59
LM319	1.25	LM389	1.35	LM1303	1.95	LM3905	1.25
LM320 (see 7900)	LM390	1.95	LM1304	1.19	LM3909	.98	
LM322	1.65	LM392	.69	LM1305	1.49	LM3911	2.25
LM323K	4.95	LM394H	4.60	LM1307	.85	LM3914	3.95
LM324	.59	LM399H	5.00	LM1310	2.90	LM3915	3.95
LM329	.69	NE531	3.75	MC1330	1.89	LM3916	3.95
LM331	3.95	NE536	6.00	MC1349	1.89	MC4024	3.95
LM334	1.30	NE555	.39	MC1350	1.29	MC4044	4.50
LM335	1.40	NE556	.69	MC1358	1.79	RC4136	1.25
LM336	1.75	NE558	1.50	LM1414	1.59	RC4151	3.95
LM337K	3.95	NE561	19.95	LM1458	.69	LM4250	1.75
LM337T	2.95	NE562	6.00	LM1488	.99	LM4500	3.25
LM338K	6.95	NE564	3.95	LM1489	.99	LM13080	1.29
LM339	.99	LM565	.99	LM1496	.85	LM13600	1.49
LM340 (see 7800)	LM566	1.49	LM1558H	3.10	LM13700	1.49	
LM348	1.20	LM567	1.29				

H = TO-5 CAN

T = TO-220

K = TO-3

RCA

CA 3010	.99	CA 3081	1.65
CA 3013	2.00	CA 3082	1.65
CA 3023	2.75	CA 3083	1.55
CA 3035	2.49	CA 3086	.80
CA 3039	1.29	CA 3089	2.99
CA 3046	1.25	CA 3096	3.49
CA 3053	1.45	CA 3130	1.30
CA 3059	2.90	CA 3140	1.15
CA 3060	2.90	CA 3146	1.85
CA 3065	1.75	CA 3160	1.19
CA 3080	1.10	CA 3401	.59
		CA 3600	3.45

TI

TL494	4.20	75365	1.95
TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
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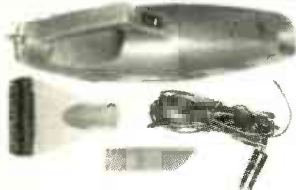
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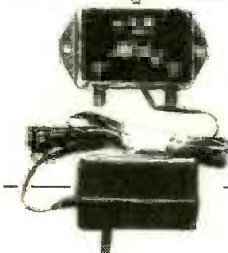
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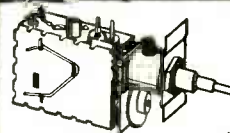
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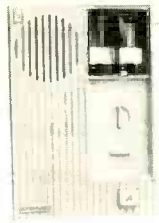
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Free Information Number	Page
42	AMC Sales.....157
—	ATV Research.....170
—	Aaron Gavin.....158
54	Abex.....31
67	Active Electronics.....165
69	Advance Computer Products.....183
—	Advance Electronics.....20-21,38
35	Advanced Tool Technology.....151
72	All Electronics.....168
27	William B. Allen Supply.....154
43	Anders Percision Instrument Co., Inc.....153
81	Arizona Electronics*.....185
25	BBC Metrawatt Goerz.....145
79	B.G. Micro.....184
39	B&K Precision Dynascan Corp.....156
—	Bagnall Electronics.....160
—	Karel Barta.....163
9	Beckman Instruments.....Cover III
—	Bullet Electronics.....174
—	C&D Electronics, Inc.....176
—	CIE, Cleveland Institute of Electronics.....34-37
91	Chaney Electronics.....182
48	Command Productions.....154,162
14	Communications Electronics.....2
28	Components Express.....84
3	Compuserv.....80
82	Computer Products & Peripherals Unlimited.....184
29	Concord Electronics.....102
76	Consolidated Electronics, Inc.....163
—	Cook's Institute.....162
8	Cooper Group.....Cover II
59	DX Tele-Labs.....31
—	Dage Scientific.....160
—	Devtronix/Organ Products.....160,170
—	Digatek Corp.....164
92	DigiCom Engineering, Inc.....185
63	Digi-Key Corp.....161
74	Dokay.....174
—	Edu Calc.....32
98	Electronic Rainbow.....42
41	Electronic Specialists, Inc.....157

—	Electronic Technology Today.....90
—	Electronics Training.....152
—	Enterprise Development.....159
65	Ecto Electronics.....169
47	Etronix.....158
—	Fordham Radio.....162
—	Formula International.....44,177
—	Galaxy Electronics.....168
—	Gilco International, Inc.....185
—	Gladstone Electronics.....159
—	Global TV Electronics.....164
—	Godbout Electronics.....59
—	Grantham College of Engineering.....155
—	Hal Communications Corp.....24
—	Hal-Tronix.....170
21,15	Heath.....26,78-79
—	The Heath Group.....28
—	Hickok Electrical Instruments.....147
—	Hitech Electronics.....174
—	ISET/NESDA.....134
—	Information Unlimited.....170
—	International Crystal.....157
61	JDR, Microdevices.....178-179,180-181
—	J&W Electronics.....160
—	Jameco Electronics.....172-173
—	Jensen Tools, Inc.....31
—	Kikusui International Corp.....1
—	H.J. Knapp.....184
—	LT Sound.....168
—	McGee's Radio.....168
—	McGraw-Hill Book Co.....136-139
—	Memotech Corp.....11
—	MicroManagement Systems, Inc.....158
—	Microtenna Associates.....160
—	Mikos Inc.....77
—	Monarchy Engineering, Inc.....176
—	Mountain West Alarm.....162
—	Mouser Electronics.....185
7	Multitech Electronics, Inc.....96
—	NRI Schools.....16-19
—	NTS Schools.....118-121
32	Neptune, Communications, Inc.....147
—	Netronics.....58,151
12	New Tone.....29
19	Non Linear Systems.....5
16	North American Soar.....27
10	O.K. Machine & Tool.....25
75	Omniatron Electronics.....176
18	PC Guide.....103
80	P.P.G. Electronics Co. Inc.....182
55	Pacific One Corp.....31
37	Pac-Tec Corp.....159
45	Paia Electronics.....145
—	Philips ECG.....13
11	Philips Test & Measuring Instruments.....23
56	Phipps & Bird.....31
77	Poly Paks.....186
5	Protecto Enterprises.....72
31	Quest.....94
17, —	RCA.....95,152,153
4,66	Radio Shack.....52,171
64	Ramsey Electronics.....167
93	SCR Electronics, Inc.....182
68	SJB Distributors, Inc.....175
51	SMP, Inc.....31
94	SRJ International.....186
96	H.W. Sams.....63-71
—	Satellite TV.....164
—	Simple Simon Electronics.....117
—	Sinclair Research Ltd.....8-9
73	Sintec Co.....170
20	Solid State Sales.....164
73	Sony Video.....22
84	Spartan Electronics.....182
24	A.W. Sperry.....30
71	Stavis Electronics, Inc.....166
—	Suntronics Co., Inc.....166
49	TNW Corp.....134
13	Tab Books.....15
—	Tektronix.....7
38	Triton Mktg. Corp.....155
53	Ungar.....31
52	Video Control.....31
58	Video Mods.....31
2	Viz Mfg. Co.....33
86	Wersi Electronics.....163
44	Zemog Scientific.....134
—	Zenith Radio Co.....Cover IV

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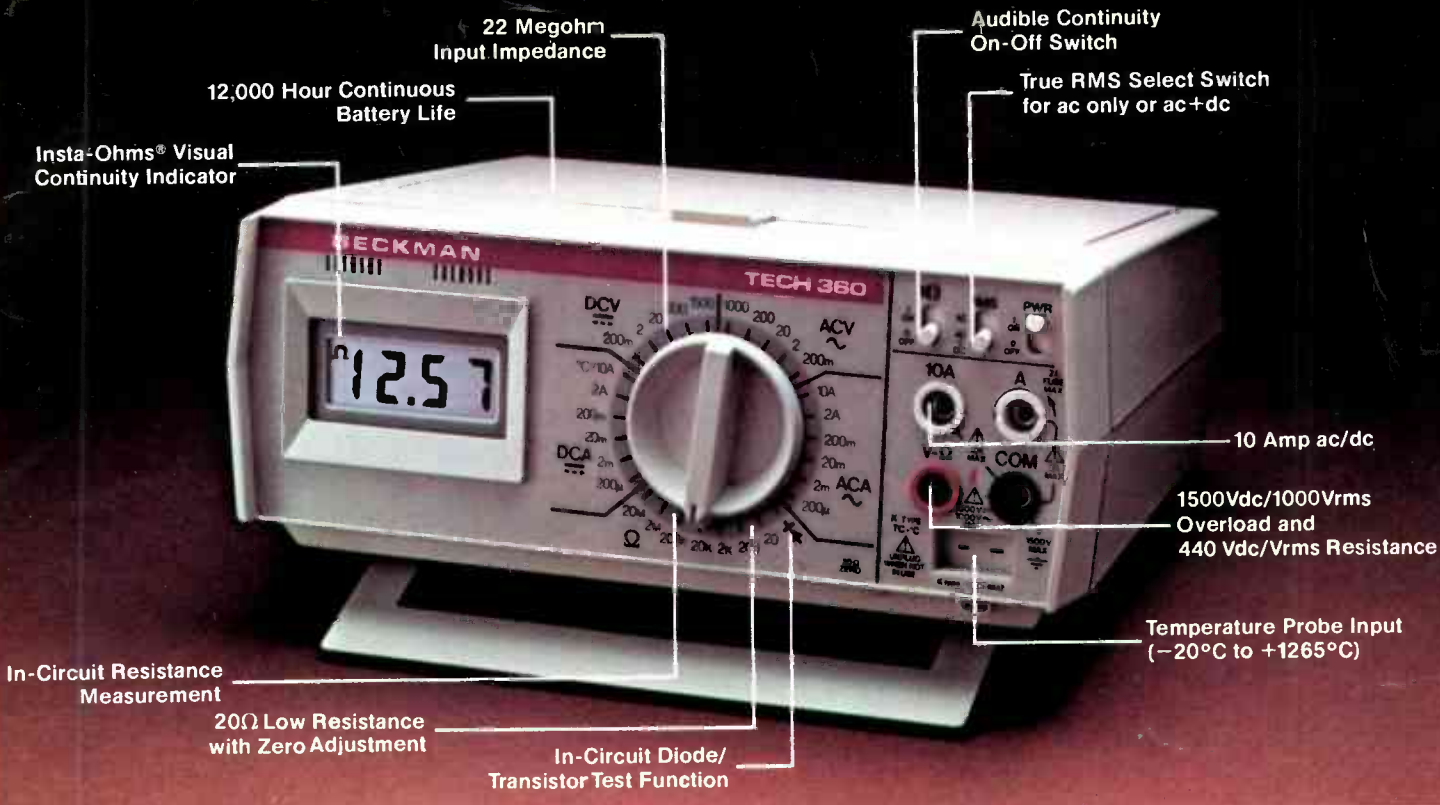
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