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- Entire capacity of minifloppy under the heads at all times (400,000 byte cylinders)
- Up to 20 cylinders available, 5 ms cylinder/cylinder
- 2 inch overall height (min.)
- Up to 6.25 megabit transfer rate

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think of me as a DISK SYSTEM
because I have the convenience of a removable cartridge and fit in the space of a 5¼" floppy:
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TM990 Series 16-bit microcomputers: Shortcut to industrial control solutions. The wide choice from Texas Instruments.

Solve a majority of your industrial control design problems rapidly. Economically. Efficiently. TI's broad TM990 Series of microcomputer modules can match your needs down the line. And off the shelf. Saving design time and money because they are pre-assembled, pretested. Giving you all the performance of TI's 16-bit 9900 microprocessors.

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If you need a high-performance general purpose 16-bit CPU, then the new TM990/1481 two-board CPU is your answer. With 95 distinct instructions, it has the processing power of a minicomputer.

While the TM990/1481 is 3½ times faster than other TM990 CPUs when executing non-floating point instructions, it shines at floating point arithmetic. It is 40 times
In fact, the TM990/1481 performs double precision floating point in the same time as it takes competitive products to perform single precision.

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Your choice in TM990 memories includes a variety of directly addressable semiconductor memory modules.

There’s also provision to handle floppy disks drives. The TM990/303A controls up to four standard drives or three mini diskette drives.

Exceptional I/O capability
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Recently added to the TM990 line are two new communication modules. The TM990/308 Industrial Communication Module permits communication with as many as 31 other compatible TM990 systems. Over distances up to 10,000 feet, using twisted-pair lines. The optically isolated interfacing built into the 308 simplifies interconnects and lowers installation costs even in electrically noisy environments.

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Functional integration. Hardware and software units developed together. To work together. TI is first with this system concept of the 80’s that can substantially cut software development time and costs.

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TI’s powerful AMPL hardware and software development system includes full speed emulation of 9900 microprocessors, and provides for program development in assembly language, TI Microprocessor Pascal (complete with concurrency), and Power Basic.

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The TM990 Series is supported by a broad selection of accessories — card cages, connectors, cables, and power supplies. Just added: the TM990/522 Enclosure containing a four-slot OEM chassis, power supply, and cooling fan in a neat, attractive, table-top unit.

For faster, simpler solutions to industrial control problems, take the shortcut. The TM990 Series of microcomputers. For more details about these time and money saving modules, see your local TI distributor, or fill out and return the coupon.
The DC-12068 prints 12 characters/line nominal, but is capable of 15 columns. It is sized for portable hand-held applications with 1.7” H x 3.2” W x 3.7” D and 5.3 ounces. It prints 5 lines/sec on 1.4” paper and is $35 in quantity. Other printers with interface electronics available.

Call or write HYCOM, 16841 Armstrong Ave., Irvine, CA 92714 — (714) 557-5262

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Circle 3 on Reader Inquiry Card

Rsx -11 MCommand Language

The HANDY printer.

New low price.

The DC-1206B prints 12 characters/line nominal, but is capable of 15 columns. It is sized for portable hand-held applications with 1.7” H x 3.2” W x 3.7” D and 5.3 ounces. It prints 5 lines/sec on 1.4” paper and is $35 in 1000 quantity. Other printers with interface electronics available.

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The HANDY printer.

New low price.
When you start comparing color graphics systems, the Xerox 6500 Color Graphics Printer looks very, very good. Any way you slice it.

Not only can it produce computer-generated full-color graphics at a rate of three a minute, it can produce them at a cost of 6¢ apiece. On paper, or overhead transparency. It can even print from 35mm slides.

And you don't need to be a computer genius to operate one.

If you're thinking of taking your company to color, call the Xerox Printing Systems Division sales office nearest you. And take a long look at the Xerox 6500 Color Graphics Printer.

It could make your decision as easy as pie.
unaddressed problem

Dear Editor:

One problem not addressed by your other letter-writers involves philosophical differences (mores, etc.) of (mainly) non-Western foreign-born engineers (FBEs). Ethical definitions are not necessarily the same, and this can be critical when we’re trying to safeguard our technology. I recently had the experience of working for an East Indian national who sought out new grads from universities catering to foreign students. He admitted that he could double his staff this way since these students would do anything for sponsorship. The personnel department did its share in working around Labor Department loopholes. This guru sidelined real estate in order to profit from the housing of his “captive” engineers. I don’t believe that this is an isolated case. An epilogue to the above has the East Indian out of work due to the poor performance of his division and 90% of his people (mainly FBEs) out of work and sponsorship.

Irwin Feest is not all wrong!

F. D. Smith, P.E.
W. Melbourne, FL

P.S. My father and mother were foreign born, but 1900 — not 1981.

like the Mafia

Dear Editor:

I am not against anyone hiring anyone at any salary. The FBE issue is a small part of another problem: there are many U.S. employers with managers who exploit engineers by deliberately writing schedules that automatically force engineers to work unpaid overtime to accomplish unrealistic schedules, etc. These companies have a high number of FBEs, who are willing to put up with crap from these abusive companies. Hence, engineers gripe against FBEs. Since there is no watchdog over management abuses, many engineers point at the FBE problem.

The real problem is that there is no organization to which EEs can bring grievances. Even a simple organization that rated companies according to its poor performance of his division and 90% of his people (mainly FBEs) out of work and sponsorship.

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W. Melbourne, FL

P.S. My father and mother were foreign born, but 1900 — not 1981.
immigration procedures, and you CAN blame the Government and your Congressman for looking the other way!

My thoughts on AAES? It is the typical IEEE subterfuge to escape responsibility. But, on the other hand, what can you expect of an organization made up primarily of dum-dums under the control of industry execs and university professors?

Name Withheld Upon Request
Tennessee

turning off motivation

Dear Editor:

Are aliens entering the U.S. at too high a rate to be properly assimilated? This may or may not be "real", but since EEs perceive it this way, this problem affects American views of FBEs. But companies improperly utilize EEs. Is the salary scale being depressed by the influx of aliens?

Engineers could be more effectively utilized if provided with better tools, and/or more support. Management prefers the brute force method: just hire more engineers. At current salaries and benefits, engineer vs. technician salaries may be too close to not want to hire an engineer for mostly technician work.

Once in the U.S., based on their technical skills, many FBEs migrate into management. Good technical people do not necessarily make good managers, and FBEs are at a disadvantage because of lessened communication ability and possibly different cultural backgrounds. We have some FBE managers here who are good for turning off employee motivation. However, FBE managers like to hire more people of their own background.

Name Withheld Upon Request
San Jose, CA

Well, to begin with, color graphics.

RCA's VP-3301 has unique color-locking circuitry that gives you sharp, jitter-free color graphics and rainbow-free characters.


The VP-3301 can be used with a 525-line color or monochrome monitor or a standard TV set through an RF modulator. It serves a wide variety of industrial, educational, business and individual applications including communication with time sharing and data base networks.

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So get the whole story about the surprising VP-3301 today. Write RCA MicroComputer Marketing, New Holland Avenue, Lancaster, PA 17604. Or call toll-free: 800-233-0094.

RCA

*Model VP-3303 with built-in RF modulator—$270.  O.E.M.
*Quantity price. Monitor and modem not included.
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An impressive array of state-of-the-art controllers, all built around high-speed bipolar microprocessors. All software compatible with the host LSI-11® or PDP®-11 minicomputer...and all available now.

And Dataram's controllers are designed to save you money, and a lot more. Like space — our controllers typically occupy half the space required for the comparable controller from DEC. Doing it with a level of performance that makes any member of this family worth looking at.

Look at the chart of our current family of peripheral controllers, growing every day. If you don't see the controller you need, we're probably working on it right now. Call us and discuss your requirements.

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Second Industrial Revolution

by Jeffrey C. Hoopes, Associate Publisher

Digital Design is rapidly approaching its ten year anniversary serving the computer industry. Needless to say, we’ve witnessed incredible growth in the market while, in the process, our publication has changed over the years to react to and meet the needs of designers working in this dynamic industry.

It is in that spirit of change that the COMPAT ’81 show and this special COMPAT ’81 Directory were conceived. The response was so tremendous from Computer Compatible Equipment Manufacturers that we were forced to run the directory in two parts. After the second half of the directory appears in September, we hope to be doing much more in the areas of compatibility in upcoming issues, while helping to further define the market for computer compatible products in general. Hopefully, these efforts will persuade other computer publications to follow Digital Design’s lead in the future.

The key word here is future. Through our technology we all have the task, indeed the mission, to effect great change in our lives today, and the future of modern civilization itself. That’s quite a responsibility to bear. However, it’s one that I’m sure you already realize by working in this wonderful field.

As I see it, the computer industry is, in fact, the Second Industrial Revolution. New designs are coming from your offices every year. New products are being designed by the thousands to conform to size, weight, speed and efficiency characteristics. If you haven’t guessed already, I happen to be a technological optimist. As our lives and society become increasingly complex, I have faith that you, the designer in the computer industry and your fellow designers in other industries, will continue to solve today’s seemingly gargantuan problems with tomorrow’s innovative solutions. As designers, you remain the world’s greatest natural resource.

To help you meet those increasing demands, Digital Design will continue to provide you with practical, applications-oriented editorial that you can use today to solve your engineering problems. Your correspondence indicates that you find our directories and showcases of particular value in keeping you abreast of the current state of the art in various products and technologies. We will continue to do these showcases while providing you with new, innovative and important editorial that you need to maximize your talents. A recent reader survey conducted by the Starch Ballot Company for Digital Design shows a total audience of 195,000+ designers reading Digital Design each month. I thank you for your interest in Digital Design and always welcome your comments on how we can serve you better, or how you like what we’ve done in the past. In the meantime, I hope you’ll enjoy our first COMPAT ’81 show issue. We feel it’s an idea whose time has arrived.

Jeffrey C. Hoopes
Build your own DEC system with CRDS...

**MF-211**
10½" Enclosure for LSI 11/23 System with built-in RX02 equivalent floppy disk system. Available with or without processor and memory.

**HD-11/T**
20.8 Megabyte Winchester disk software equivalent to 4 RL01 units. Optional cartridge tape backup.

**FD-311**
RX02 equivalent dual floppy system, single or double sided. Includes bootstrap loader, self-tester, format and diagnostic diskette.

**MB-211**
5¼" enclosure with 8 quad slot backplane. Front panel console with switches for Enable/Halt, Boot/Init and Line Time Clock.

Complete software compatibility at a savings!

With CRDS, you can configure your own DEC system and be assured of complete software compatibility. Each of the above systems is provided with slides for rack mounting or can be used in desk top applications. All DEC LSI 11 based modules and associated software packages are available through CRDS, if desired.

**Attractive Packaging**
Careful attention is given the CRDS repertoire of enclosures in assuring you an attractive yet comfortable blending of product in the DEC environment.

**Significant Savings**
Flexibility of procurement plus attractive OEM schedules allows you to optimize dollar savings in configuring your CRDS system. Use the time tested technique. Compare.

**Warranty and Maintenance**
A 90 day warranty is offered with your CRDS system. In the event of malfunction, by use of provided diagnostic routines, the defective submodule is normally found within minutes. After verification with the CRDS Maintenance Department, a replacement for your defective module will be promptly forwarded.

Call or write for a comprehensive literature package and prices.

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Circle 19 on Reader Inquiry Card
Computer Compatible Directory

Paul Snigier, Editor

This two-part Computer Compatible Directory is designed to serve you. As system designers and OEM integrators, you should find it an invaluable, permanent addition to your reference library. It was a mammoth undertaking. It is the first such directory ever published.

Reader and manufacturer response to the January 1981 DEC compatible directory issue — the first of its kind in the computer industry — was overwhelming. Since this directory also was the first of its kind, we asked you for your comments, corrections, additions and updates to make this expanded directory as comprehensive and accurate as possible. In addition, we mailed out even more questionnaires, reviewed more new product releases and scanned other sources for information on firms manufacturing computer compatible equipment. From this vast array of sources, we compiled this Computer Compatible Directory — the first and most formidable ever published in the trade press. In fact, it was so overwhelming that it will run in two parts. The first half is running this month; part two will appear in September.

From your enthusiastic response and recommendations, we decided to expand the coverage to include not just DEC compatible products (as big as that field is), but also to expand this directory to include all computer compatible products. Emphasis, obviously, would center on minicomputer and microcomputer compatible products for the industrial, scientific and engineering fields. In addition, the new and expanded directory would be divided into product categories to facilitate the easy location of products. This new format will now prove easier to use: simply turn to the product category, search for the appropriate products, and note the vendors' names. If you wish to contact specific firms, simply turn to the manufacturers' listing. Addresses, phone numbers and sales contacts are included for your convenience.

Although we have tried to name every manufacturer and product that we could locate, the dynamic nature and rapid growth of this field make this impossible. If you find that your firm is not listed, return the Compat Directory questionnaire so that we can include you in the next Compat Directory. Also, if you find any inaccuracies, please write, so that we can make the changes.

This Compat Directory has been a tremendously tough job. Primary credit for this mammoth undertaking belongs to our editor Martha Hawkins, without whose tireless research and editing, this directory would not have been possible.

A second industry-first is occurring on September 16th and 17th at the San Franciscan Hotel. We are launching a series of national Compat exposition shows devoted exclusively to computer compatible products — something which has never been done before, despite the rapid growth of DEC, DG and other computer compatible products in the past several years. Subsequent Compat expositions will be held several times a year at different locations to bring computer compatible, plug compatible manufacturers together with interested OEM designers and system builders.

We want to eliminate the "fans" (those curiosity seekers cluttering up too many other conventions) and bring the "players" and plug compatible manufacturers together. We want to improve the signal-to-noise ratio by eliminating the noise and increasing the signal.

Be sure to visit Compat. You'll see new computer compatible products, attend seminars and talk to exhibitors in a vertically-structured environment of computer compatible manufacturers and products.

Paul Snigier
Condor has a permanent cure for your switcher problems. It's Condor's all new line of NATURAL LIGHT Switchers. A wide range of inputs, low prices, plus Condor's advanced design and quality make these switchers your best buy. For your 1st aid problems, take advantage of our FREE 1st Aid Kit in a Can offer. Details below.

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With every order for 5 or more Natural Light Switchers, we'll send you this unique and complete 1st aid kit in a can. Includes 10 plastic strip band-aids, 5 sterile pads, roll of gauze, roll of adhesive and tube of antiseptic solution, sealed in a pull top can with plastic lid for resealing. Lid has a coin slot, converting it into a savings bank when kit is used up.

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(805) 484-2851

Circle 11 on Reader Inquiry Card
Guest Host Dichroic LCDs Add Color

LCDs continue to make advances. Designers employing LCDs for indication in instrument or industrial applications are no longer limited to displays with black segments on a light colored background. The introduction of a new line of Hamlin color LCDs offer a wide choice of color combinations for both digit segments and background. The new line offers a display with higher contrast, extremely wide viewing angle and high reliability for viewing in a wide range of lighting conditions. They are ideal for use in avionics, instrumentation, medical equipment, home appliances, pocket computers, programmable calculators, games and many other applications.

These color LCDs are of the negative "guest"/"host" type and employ a liquid crystal fluid as the "host" and a dichroic dye as the "guest". Using this advanced technology, Hamlin developed single layer displays for either transmissive or reflective viewing. The transmissive type incorporates a single polarizer and is back-lighted; the reflective type uses neither a polarizer nor backlighting but employs a reflector on the back of the display. Both types are being offered as two-color displays, with clear segments on an orange, blue, black or violet background. The additional colors of green and red should be available in the near future.

Color LCDs which employ their standard twisted nematic displays with a dichroic front polarizer are available. This offers two-color viewing — red digits on a blue background or blue digits on a red background, for example.

Development of guest/host color LCDs includes double layer types for viewing of information in as many as three colors. They offer the possibility of varying the segment color by applying various drive signals. The display can be viewed with clear, light blue, or orange segments on a dark violet background. The color of all segments can be individually controlled by the drive circuitry. Additional color combinations will be available in the near future.

The new color LCDs come in many sizes, depending on type desired. The single layer transmissive mode display can be furnished in all sizes offered in the present Hamlin line — as small as $1.2'' \times 0.9''$ or as large as $6'' \times 2''$. Reflective mode displays are available in all sizes up to $2.75'' \times 1.5''$. All have an operating temperature range of $-20^\circ C/+90^\circ C$. They can be used with operating voltages of 3V min. to 10V max. Typical response times are under 250 Ms.

While prices of Hamlin Color LCDs exceed those of conventional field effect types, they are only 25% to 50% higher, depending on type. The new displays could eventually be priced competitively with existing types.

Want immediate samples of the single-layer transmissive-mode color LCDs? If so, contact Hamlin directly at Lake & Grove Sts., Lake Mills, WI 53551. (424) 648-2361. Single layer reflective and double layer types can be furnished as samples in 12 weeks.
Non-Impact Printer Market Grows

The market for non-impact printers will pass $1 billion this year, and will grow to more than $3 billion by 1986. The largest growth area will be for small electrophotographic units, many of which will be based on office-copier mechanisms. "Very strong" growth is also projected for ink jet printers.

IBM's 5670, announced in 1979, had "lukewarm" sales; Xerox's 5700 and Wang's Image Printer didn't do any better. "There is a great future for intelligent copier/printers, but IBM's 5670 Information Distributor was priced much too high, at $75,000, for most users' budgets, and it's been a marketing disaster," according to Kenneth G. Bosomworth, President of IRD (at 30 High St., Norwalk, CT), who participated in the study. This abstract was condensed from IRD's report #173, "Non-Impact Printers" ($985).

Electrophotographic printers will prosper until 1986; after that, high-end market saturation will bring shipment value down in the latter part of the decade. Thermal printer shipments will remain strong, doubling between 1981 and 1986, but suffering from increasing price erosion later. An increase is unexpected in electrostatic printer shipments, which should suffer from increasing availability and falling prices of copier derivative electrophotographic devices.

Although Honeywell had significant successes with its PPS electrostatic printer, many placements of Honeywell equipment were in specialized industry-specific environments (telephone companies, the Internal Revenue Service, etc.), where potential sites for new placements are limited. Electrosensitive printing will retain a strong position at the bottom of the market, but won't advance beyond the low end. However, the simplicity of electrosensitive printing suggests that vendors will still be attracted to the possibility of a winning product based on this technology, despite the long history of disappointments in the past. Magnetic printing will not develop into a major market segment.

supplier lineup

Xerox and IBM own most of the top end of the market at the present time.
with the 3800 and 9700. Siemens ND-2 resembles the 3800 and is resold by Sperry Univac and others. Honeywell's electrostatic printer competes at the top-end of the market; all other top-end products are electrophotographic.

At the bottom end, with strip printers for calculators, etc., Texas Instruments, Matsushita and Olivetti are major vendors, and TI also dominates the thermal data terminal market, although strong competition in the latter sector comes from Computer Devices, Computer Transceiver Systems and others.

Wang Laboratories competes with IBM and Xerox in the intelligent printer segment, which is likely to number a dozen or more vendors over the next year or two. Some entrants will procure equipment on an OEM basis from Konishiroku, General Optronics, Canon, Minolta, etc.

Non-impact printer specialty paper and supplies will be a relatively small market, particularly by paper-company standards. However, according to IRD it has been a lucrative one. Although growing markets for thermal and electrostatic specialty-coated papers will increase strongly, the most spectacular growth will be in toners and other supplies for electrophotographic printers. This area does not offer great opportunities for supply vendors, because most of these printers will be based upon standard office copiers; now supplies are readily available through stationery stores and other non-specialty channels.

Will High-Resolution Printers Dominate Market?

The 1985 sales of high quality computer printers will exceed $2 billion. Manufacturers of matrix printers with a resolution higher than 180 dots/inch will account for over 60% of this market. Fully-formed character printers are not becoming obsolete: they will ship more units in 1985 than manufacturers of high quality matrix printers — but not without a good fight.

The fastest growing subsector of the high quality printer market will be the high-resolution dot-matrix segment, which will grow at a compound annual rate of 164% from its presently small base through 1985. This market was pioneered by Sanders Technology Systems; new entrants coming in the next few years will include Florida Data Corp., Centronics, Diablo, and Integral Data Systems.

---

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**Custom Systems' Model 420 Programmable Terminal Interface (PTI):**

- Eliminates need for comm. chassis.
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<td>Perkin Elmer</td>
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II. For the CPU’s you have checked, what types of plug compatible products do you specify or purchase?

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<td>Programmable Controllers, Single Board Computers/Chips, Tape Cassette/Cartridge, Winchester Drives</td>
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<tr>
<td>B. Data Terminals</td>
<td>Alphanumeric Display Terminals, Graphic Terminals, Programmers, Printers, Plotters, Teleprinters</td>
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<td>C. Memory</td>
<td>Add-in and Add-on Memory Systems, Bubble Memory Systems, Semiconductor Memory (RAM/ROM, etc.)</td>
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<td>D. Mass Storage/Drives</td>
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<td>F. Input/Output Units</td>
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Advances in Display Technology

a review of the most important technologies and their recent advances

Displays are man-machine or man-information interface devices. Displays and printers are often called I/O devices which input information into man's brain through his most powerful sensory organ — the eyes. In this era of electronics, integrated circuits, and computers, displays have become one of the most important devices for man-machine interface.

by I.F. Chang

The two major classes of display technology, today, are Active, Light-Emitting Displays (CRTs, Plasma Display Panels, LEDs, Electroluminescent Displays); and Passive Light-Modulating Displays (Electrochromic Displays, LCDs).

In today's market, the CRT is the dominant technology, with its growth momentum remaining unchecked. As for the others, the LCDs are gaining their own market share and are doing it more rapidly than other technologies.

**CRT technology**

The CRT Display Technology can be subdivided into five categories: Direct-View Refresh CRT; Direct-View Storage CRT; Projection CRT and Light Valve; Special CRT; and Flat Panel CRT.

The most recent advance in Direct-View Refresh CRT has been cost reduction due to improvements in its fabrication. Also contributing to cost reduction has been a decrease in cost of memory. In the display tube, the electron-gun design has also been improved to show more shock and vibration resistance and better resolution. For CRT screens, some new rare-earth phosphors which allow narrow-band filters to improve display contrast have been developed. Antireflection coatings have also been widely used in applications where high ambient and directional illumination conditions exist. In the color CRT (shadow mask type) a black guard band is used around each color phosphor dot, thus improving color contrast.

The most important display in Direct-View Storage is the bistable phosphor storage CRT. In operation, a writing beam establishes a charge pattern on the phosphor screen and a flood beam maintains and displays such a pattern through a secondary electron emission process and low voltage (200-300 V) cathodoluminescence. It initially was used mainly for oscilloscope application and only recently was entered into the information display market. The significant advance made is the size of the display screen. In 1963, only a 5" diagonal screen was possible. A 25" diagonal storage CRT display is now available with write-through feature, a writing speed of 15000 cm/sec, a resolution of 15.75 line pairs/cm and brightness of about 8.6 ml.

Another storage CRT display is the cathodochromic CRT (CCRT) which utilizes, instead of a cathodoluminescent screen, a cathodochromic screen which changes into dark color upon electron-beam excitation. The most efficient cathodochromic material developed is the alkali-halide-doped sodalite. Although a direct-viewing CCRT has been
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developed, a more useful version, perhaps, is a projection system where the sodalite material is deposited on a metallic target and the image is projected onto a 1.22 × 1.83 m² screen through a reflection lens. The advantages of the CCRT are high resolution and freedom from flicker. Its primary drawback is that full-screen erasure is slow, typically 3 sec.

The shadow-mask Projection CRT can produce more than 100 FL on its faceplate because of its higher heat tolerant mask, higher transmission faceplate glass, and removal of black guard band around the color phosphor dots.

The second type of projection TV is a CRT Light Valve known as the Eidophor. The oil-film light-valve system manufactured by GE extends its application to simulator displays and command-control systems by improving the light valve’s resolution to 650 TV lines vertical from 350 TV lines.

An important Special CRT for high-resolution color display applications and a competitor to the high-resolution shadow mask and beam-index color tubes mentioned earlier is the “penetration CRT.” It is the same as an ordinary CRT except its screen is prepared from a penetration phosphor. The penetration CRT is based on the principle that different energy electrons have different penetration depths in the phosphor. When the CRT screen is made of multilayer penetration phosphors of different colors, one can obtain color modulation by switching the beam voltage. One usually can obtain four colors in penetration CRTs. The problems in this technology are in the high-voltage switching circuit which is expensive and in the limitations of brightness andswitching speed which restricts the color information presentation in a sequential color frame mode.

Flat-Panel TV display is a long-term goal of many display technologists, although there is no technology yet in sight for replacing the shadow-mask color CRT. There have been several exploratory efforts in the past to develop a flat CRT such as Aiken & Gabor tubes. One of the more-developed e-beam flat-panel CRTs is the Digispay initially introduced by Northrop and later modified by Texas Instruments. This device consists of an area electron source made of a number of line cathodes, a set of spatial selection grid plates which selects the beam over 512 × 512 spots to excite the phosphor anode. The modified version has made significant improvements in device fabrication and cathodes and their electron optical design. Although the performance of this device was rather good, the technology seems to have been shelved for production cost reasons.

A flat cathode-ray display device, which has really obtained a market share, especially in the small display area (several characters or digits), is the ZnO vacuum fluorescent panel (VFD). This technology is competing with the LED, PDP, and LCD in several application areas including use in the automobile.

plasma display panels (PDP)

Gas discharge is a breakdown phenomenon in which the current will continually increase unless it is limited by a load resistor (operable under both dc and ac voltages) or a capacitor (operable under ac voltage only). The latter operation exhibits a memory effect because the charge deposited on the wall during a gas discharge will aid the polarity-reversed applied voltage to break down the gas again; thus, once initiated, a gas discharge can be maintained with a lower magnitude of applied voltage in the alternating mode.

The "ac PDP" consists of a matrix of gas discharge cells defined by two sets of orthogonal insulated electrodes deposited on two glass substrates which are properly separated, filled with neon-argon gas and sealed. The device was first reported in 1964. The advances made in this technology can be divided in three groups. The first group is the exploration of new driving techniques and various functional effects such as light-pen interaction, direct electrical readout, cursor action, and the ability to achieve gray scale. The second group is the development of integrated drivers and fabrication techniques with the hope of reducing cost. The third group is the exploration of color and TV display possibilities. However, the third exploration has not yielded any practical devices. The problems are in the incorporation of color phosphors into the panel, achieving high luminous efficiency and avoiding cross talk due to UV light spreading. Nevertheless, the ac PDP is a serious competitor to the CRT display, and its main problem is in its fabrication and electronics cost. The largest panel presently available is a 512 × 512 panel (23.6 lines/cm), although a 1024 × 1024 (32.7 lines/cm) panel has been attempted.

The first widely used "dc gas discharge display" was the Nixie tube invented in the early 1950's and manufactured by Burroughs Corporation. Since then more advanced numeric panels known as Panaplex and an alphanumeric panel known as Self-Scan have been developed. The Self-Scan PDP consists of a set of display anodes, in front, which are connected to the information line drivers, an orthogonal set of cathodes, in the middle, which are multiphase driven in a self-scan manner, and a set of scan anodes, in the rear, which are orthogonal to the cathode lines and connected together through resistors. Apertures are made in the cathodes to allow the priming discharge from the rear to go through the aperture and enter into the display section if the display anodes are selected, i.e., have voltage applied. Synchronized with the priming discharge, the display anode should be scanned above the visual flicker frequency. As the number of characters is increased, the time allowed for discharge transfer is reduced, which may result in ambiguous priming and, of course, lower brightness. Therefore, there appears to be a limit for practical panel display on the order of 200-300 scan cathodes. Recently, thick-film techniques have been used in panel fabrication which, along with integrated drivers and high-voltage logic, have reduced the device cost considerably.

The dc PDPs do not have memory as do the ac PDPs. However, memory may be obtained by incorporating a thick-film resistor at each cathode or a spiral-shaped thin-film resistor at each anode or by using a graphite cathode which limits current flow without additional resistance. However, to date these developments have not given rise to commercial devices.

LED display technology

Although discovered in 1922, the LED as an electronic device did not receive serious development until the mid-sixties. The recent advances in LED display are along several technological fronts. One is the improvement of efficiency and surface brightness. Several-thousand millilamberts of surface brightness can be obtained with 100% duty cycle at a current density of 10 A/cm². The second area is toward achieving higher reliability in LEDs. Extrapolating the data on percent light reduction after 1000 hr of high current stress (35-40 mA), one expects that the reliability issue is entirely insignificant in today's LEDs except for extremely high-brightness applications. The third area is the availability of color choices and diode size. There are various diode sizes of four colors (red, orange, yellow, and green) available today.
Due to the cost difference of substrates (~$10/in.² for GaAs and ~$100/in.² for GaP), the red LEDs are much cheaper than the non-red LEDs. The fourth area is the development of monolithic processing which, due to material cost, is mainly for GaAs substrate. The monolithic technology has not only yielded the seven-segment numeric digits (at ~10µa a digit price) but also the 5 × 7 alphanumeric dot-matrix displays fully packaged at $1/character. The fifth area is the display panel development using monolithic LED arrays and packaged into x-y addressable panels. A 5.1 × 1.3 cm LED display consisting of four 1.3 × 1.3 cm arrays of 30 × 36 LEDs was first demonstrated in 1975. The limitations on this approach are the peak current and the resistance in the row leads in the LEDs.

Large LED display panels are presently at crossroads between monolithic and discrete assemblies. The former approach is more limited by high power dissipation and uniform yield, whereas the latter is rather limited in resolution and fabrication cost. In either case, the brightness non-uniformity from diode to diode within a batch or wafer or from batch to batch is often a problem for displays requiring gray scale through current modulation. In addition, there are still problems associated with low luminous efficiency, differential aging, and flicker due to vibration that are limiting the LED’s entrance into the large display domain.

**electroluminescent displays (ELD)**

ELDs can be divided into ac or dc types corresponding to whether they are driven by ac or dc voltage. In each type, the devices may be fabricated with powder EL or thin-film EL materials.

The “ac EL” phenomenon (electroluminescence generated by an alternating field), was first discovered in 1936 in ZnS. The early device work indicated that EL devices were short lived for both powder and thin-film devices. Attempts at making ac EL TV have not resulted in a practical device, but have come closer than almost any other flat-panel technology. In the early seventies, a development effort led by Signatron succeeded in fabricating ac thin-film EL devices with reasonable life and brightness. Recently, researchers at Sharp Corp. have made a significant breakthrough in achieving high brightness and long life ac thin-film EL (ACTEL) panels. The reliability of the ACTEL devices not only depends on the quality of the polycrystalline manganese-doped ZnS layer, but also on the breakdown strength of the insulating layers sandwiching the ZnS layer. The EL mechanism is believed to be due to the electron impact excitation of the manganese ion. Since the light output of the device is directly proportional to the charge flowing through the capacitative layers per pulse, the number of pulses per second and the voltage across the ZnS film, one expects to have higher efficiency if high dielectric constant and breakdown strength insulator films are used. The sharp voltage threshold, fast turn-on and turn-off response times, and high peak brightness make this device one of the attractive candidates for a refreshed matrix display.

The “dc EL” also has a long history. A significant dc EL powder device consisted of a layer (~50 µm) of fine ground (~0.5-1 µm) manganese-doped ZnS powder coated with CuS. The device requires a high current forming process to establish a stable active region (~1000 A) at the anode. The devices of today can give several hundred foot-lamberts of brightness and a 1000-hr half-life.

The dc EL powder has also been shown to respond to fast dc pulses with a fairly steep voltage dependence, therefore making matrix address feasible. A 1250-character alphanumeric panel which can be operated at 120 V with 15-µsec pulses and a 0.5% duty cycle for 8.6 mL has been developed at the Royal Signal and Radar Establishment Laboratory. Because of these interesting properties, this technology is being considered by several auto manufacturers. The potential low cost of the dc EL device (due to ease of fabrication) and its moderate operating voltage (in the high duty cycle) are its main advantages.

**LCD display technology**

In 1964, workers at RCA Laboratory discovered a string of electro-optic effects in liquid crystals. The first was the guest-host effect, which is a color change due to reorientation of a pleochroic guest dye molecule along with the nematic liquid crystal host under applied field. Second was the dynamic scattering effect, which is a turbulence induced by the applied field in the transparent liquid crystal. A third effect was a phase-transition storage effect which was discovered in the cholesteric-doped nematic liquid crystal, permitting light to be transmitted through a pair of cross polarizers sandwiching the liquid crystal.

Today, the most developed LC product is based on the twist nematic (TN) field effect. In such a device, light polarization is normally rotated in the liquid crystal. On the other hand, when an electric field is applied, the twisting structure is neutralized, and light cannot be transmitted. In recent years, this device has dominated the electronic watch display.

The most significant advances in the LCD are in materials and device fabrication. A variety of high-purity LC materials has been developed with reasonable operating temperature range (0-80°C. ± 20°C). LC alignment techniques have been developed to achieve a low tilt angle (tilting of LC molecule axis with respect to the surface of substrate) for multiplex drive. The device reliability was improved significantly when a glass frit seal was employed to eliminate moisture.

Because of their low power requirement, LCDs are quite attractive for many applications; however, liquid crystals have some serious problems, such as low speed, poor threshold, viewing angle restrictions and temperature dependence. Temperature compensation circuits may cure the latter problem, but the rest are intrinsic to LC material properties.

**electrochromic displays (ECD)**

An electrochromic display was first reported by Deib in 1969. In 1973, the writer started a research project to investigate the feasibility of various electrochromic and electrochromic effects for display applications. The word “electrochromic” describes a color change effect induced by an electric field or current, whereas “electrochromization” (ECC) strictly applies to a color change effect induced by an electrochemical reaction, such as a redox reaction. Conclusions have been made that, due to the charge responding characteristics and slow response of both EC and ECC devices, these materials are not suitable for matrix addressing of any significant matrix size. The only practical addressing schemes are either using optical or electron-beam addressing, or using TFT or silicon transistor arrays for latching and addressing. However, to date there are no significant advances made in these areas.

*This article was extracted from a paper entitled “Recent Advances In Display Technologies” delivered by Dr. Chang at the 1980 meeting of the Society for Information Display.*
Power Supply Selection Criteria

specifying a power supply? follow these selection criteria

This article examines the specification of switching and linear power supplies, the control of EMI and PC board-mountable power sources.

Today's switching or linear power supplies require that you make more than just a few preliminary system power estimates; supply technology has gone through rapid change. If you allocate less time to power supply considerations and put off specification to the final portion of your design project, you will inevitably discover that the power supply is underpowered, must fit in one-third the space originally allocated, and that the originally-specified supply cannot meet the increased power demands of the final system design. The trend is towards purchasing. But if you decide to build, you need more expertise than you did in the past.

by Paul Snigier, Editor

Despite slowed growth, linear power supplies still take a major portion of the OEM market simply because switching power supplies cannot equal engineering advantages of these linear supplies. Although inefficient, heavy and bulky, linear supplies do provide faster response to transients, lower cost, under 150-W units, better regulation, low RFI output, ease of adjustment, low ripple output and lower field trouble-shooting. Although growing at one-third the rate of switchers in annual sales, linear will continue to take a good share of the market. Reliability of linear power supplies is quite adequate, provided heat dissipation is properly accounted for. Since the efficiency of linear (40%) is half that of switchers (75% or better), heat dissipation is a serious problem. Larger heat sinks are necessary, particularly in more compact, smaller linear; and, in many cases, forced-air cooling is mandatory. With more than twice the efficiency, switchers need fewer cooling considerations, and more often than not, can get by with only convection cooling.

Although linear efficiencies will continue to improve beyond the 55% or better which has been reached, any significant improvement beyond this point is unlikely.

Future improvements in linear power supply efficiency and heat-handling capability will probably come with the improvement of materials and the usage of ferroresonant transformers, thus minimizing voltage drop in the linear-regulator series device. With higher-efficiency transformers, the volume and weight of modular power supplies will decrease. Improved grain-oriented steel permits smaller laminations. But it also raises transformer temperatures.

Improper heat sinking and cooling reduce linear power supply lifespan considerably. An MTBF of 100 kh at 25°C might be reduced fourfold to 25 kh at an operating temperature of 55°C. System designers have used various methods of measuring computer system power supply operating temperatures. (See “Special Report: Power Supplies”, P. Snigier, Digital Design, February 1980, pp. 50-62.) Infrared scanning techniques have confirmed that switching power supply temperatures are more uniform over the supply, whereas linear power supplies are much less uniform. This means that orientation of a linear power supply is generally more critical than with a switcher. These hot spots can be up to 50°C above the overall background temperature! However, if oriented properly and cooled correctly, there is no reason for a linear supply to not function properly for decades without any change in its operating characteristics or destruction of its components, such as its electrolytic capacitors.

are linears still more reliable?

Despite improvements in switcher reliability, linears are superior in reliability simply because their technology is tried and proven, the units are easier to test and adjust, and are easier to troubleshoot. If a linear power supply does fail, it is
generally easy to find a replacement. Not so with a switcher. Switchers involve switching transistors, which are far more susceptible to large-voltage spikes. And loop stability problems are not exactly easy to diagnose or cure. Switching supplies are improving in efficiency, and the day will come in the mid-1980s when switching supply efficiency will equal that of the linear supply.

Is it possible that switching supplies will exceed linears in other areas? Not very likely. Output ripple under 3 mV p-p is common for linears. But try getting anything much below 25 mV p-p on switchers. Linears remain RFI-free and are not the source of EMI, unlike so many switchers. Linears are a safe bet when meeting VDE 0871/6.78 noise requirements. Even at that, many linears in the past were without line filtering. The reputation of switching supplies for not passing VDE requirements is legendary. If a computer system must pass VDE requirements in one country but not in another, then often it is not necessary to specify two different switchers to lower system and marketing cost. Of course, switchers also have slow response time to line for load transients. A typical switcher needs 10 to 50 ms. Linears could respond in 50 μs in response to a 50% unit load change.

**line-voltage inputs**

Encapsulated linears available for PCB mounting with line-voltage inputs (115 Vac) are known as ac-dc units. Many ac-dc unit manufacturers also offer these ac-dc linear supplies. With encapsulation, these small mountable units can resist shock and vibration, high humidity, corrosive atmospheres and other severe environmental problems. In addition, direct mounting of these encapsulated units mitigates special and costly production equipment that would otherwise be used.

Open frame linears continue finding new uses, and their sales are growing. Advantages include price, delivery, hardware features, strapping, repairability and other factors. Manufacturers of open frame linears claim higher MTBFs.

**switchers improve**

Although noisy, slow to respond to changing loads, complex, more difficult to design, suffering from other problems (such as expense, RFI and difficulty of adjustment), switchers do provide advantages that include much higher efficiency (75% versus 35%-40%), smaller size, lower weight and longer hold-up time. This last advantage provides for more orderly shutdown or switchover to UPS during a dropout. Switching power supplies provide double the efficiencies of linears. In this age of dwindling energy sources, switching power supplies have an edge: they use energy twice as efficiently. Sophisticated system purchasers and users take overall cost into consideration more than they did in the past. For this reason, switcher advantages more than compensate for extra cost. Switching supply manufacturers claim that supplies will become less noisy, will respond faster and will drop in price.

Lower filter inductance will speed response, and frequencies of switchers will continue to rise, although lowered filter inductance and improved response will worsen ripple current. Compensating for this increased ripple current, improved output filter capacitors with their lower ESRs will cut ripple. Semiconductor manufacturers — now that they have begun to understand power supply technology — are providing improved IC circuits that will keep noise down. As a side effect, the new ICs, although more complicated, are reducing parts count, cost and improving reliability.

Improved MOSFETs and new materials for inductors and transformer cores will boost switching frequencies, thus reducing weight and size and improving reliability. Is there a limit to the practical upper frequency the switchers will attain? Yes. But at present most switchers have a distance to go. Originally at 25 kHz, switcher frequencies are now up to 200 kHz. There is much room for improvement with commonly available switchers on the market. With higher frequencies, will switcher efficiencies improve above the 75% to 90% range that we now see? Perhaps, but it will not be that much more. On the other side, linears, now at the 35% to 45% efficiency range, will not become much more efficient with improved materials. Efficiencies are asymptotically approaching their limits.

Linears dissipate unreasonably excessive power on lighter loads; switchers, on the other hand, are less dissipative. Efficiency does not vary as much with the load, as in a linear, simply because of the power-input duty cycle. Pulse width modulation (PWM) techniques and improved IC devices mean that supply efficiency is more non-dissipative than in a linear supply.

As mentioned earlier, the greater inefficiency of linears, and the non-uniform heating of such supplies, makes thermal stress of linear components something to be reckoned with. Consequently, placement and cooling of linear supplies requires much greater consideration, and the margin for error is greater. With the switcher, however, operating temperature is in the 35°C region, unlike the linear (which is in the 50°C to 75°C range). Lower switching supply operating temperature means that components will be less thermally stressed. This offsets the higher MTBF rates resulting from such higher parts counts. Switcher reliability continues to improve as the regulator/controller circuit parts count is reduced with IC regulators. In addition, IC regulators make easier the task of designing and manufacturing. They offer more features than earlier devices. These include greater range of frequency and duty-cycle control, oscillator synchronization, adjustable dead time, symmetry correction, accurate voltage references, programmable voltage and current output, under-/over-voltage protection, soft-start circuitry and other features.

Is everyone switching to the newer ICs? You’d think so.
switchers beat those dropout blues

Utility company power, though it has not deteriorated as rapidly as it did four years ago, continues to deteriorate and, at the present rate, line-power dropouts (and even brownouts and blackouts) will become more commonplace as is now the case in many nations. This is due to several factors in the U.S. that include the slowdown in nuclear power plant construction, government red tape for utilities, oil prices, and the increasing use of transient and EMI-generating devices. Unlike the electronics industry, manufacturers of heavy industrial equipment (such as air compressors) are not bound by the same strict EMI requirements. Although this is unfair — and complaints have been voiced — not enough has been done about this problem in heavy industrial equipment. Compounding this problem, newer and more energy-efficient industrial equipment may aggravate the problem by generating EMI. Increasing use of microprocessors and computer systems in the industrial environment and by consumers and small businesses mean more systems will be subjected to these transient-generating and EMI-producing industrial units.

Power line dropouts exceeding single cycles (16.67 ms) occur more frequently than in the past. As mentioned earlier, switchers provide more carryover (typically 15 to 40 ms). This hold-up time can carry over the majority of such interruptions without going out-of-tolerance in their output. Output regulation for linear regulators, on the other hand, is worse.

Linear devices are less able to tolerate low-line voltages or brownouts. Switchers tolerate about ±20% of the input voltage range (90-130 V/180-260 V), while linear devices can only handle ±10% (105-125 V/210-250 V). Unlike linear devices, switchers are commonly available to tolerate even greater tolerances of the input voltage range. Certain military switchers, although costing more, can take input frequencies from dc up to 440 Hz and voltage ranges from 10 to 260 V without a variable transformer or changing transformer taps. One such unit provides ±5% from a full load up to 10% of full load, keeping a respectable efficiency of 70%. Other manufacturers provide switchers that also operate on widely varying voltage inputs. This will vary (depending upon the supply); typically it is from 90 to 250 V and may include a dc
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difficulties still plague switchers

Aside from switcher problems already mentioned — noise, EMI, spikes, greater difficulty in meeting VDE requirements, higher noise output, greater ripple — the switching supply is prone to other problems. Cost is one. Meeting the noise requirements (such as those of the FCC, EMI/RFI regulations [Docket 207080] and other regulations), mandated increased filtering. Switcher manufacturers claim this will boost prices by up to 15%. Extra filtering, components, testing and markup will account for this 15% increase in price.

Home computers, which did fall upon their own problems with radiated and conducted noise, certainly don’t need the extra problems that poorly-designed switchers could provide. With certain personal computers using enclosed supplies, the extra space for further filters and components, the problems of space and the cost cannot fail to add more to unit prices. Although open frame switchers can adapt to the extra space more readily, many need shielded enclosures — even if the personal computer is already shielded against radiated noise (which is more difficult to suppress than conducted noise). Aluminum-sprayed housing, plastic enclosures impregnated with metalized strands or particles, or more costly metal cabinets will not suffice.

Although more manufacturers claim that their switching supplies meet FCC and VDE specifications, enough supplies exist that do not (or are questionable). Requirements such as those covering noise suppression (VDE 0871/0875) have been met by some switching supply manufacturers in this country for some time. However, if the computer system is to sell in West Germany, the U.S. and the third world, it would be price-foolish to use the same supply in each computer system; each nation may require your system to comply with different regulations. Although supplies may meet FCC noise-suppression regulations, and though these FCC regulations are more lenient than VDE 0730 regulations, the FCC may upgrade its regulations to make them just as stringent.

To meet these more stringent requirements requires built-in filters, greater component spacing, wider wiring, special capacitors, transformers and inductors with greater primary-secondary voltage isolation when high-potted.

Although a number of switchers now on the market meet VDE 0871, certified supplies are still uncommon. The reason for this is that reducing conducted EMI requires line filters. This reduces the isolation voltage and raises ground leakage — sometimes to unacceptable levels. For this reason, power supply manufacturers prefer not to specify EMI standards unless the application requires it. In addition, OEMs refuse to specify a switching power supply unless they know that their computer system will be required to meet such EMI specifications.

Noise suppression means little when you’re specing for low-output ripple, since switchers are not uncommon in the 50 mV p-p range. This high ripple certainly can be filtered with external filters or clocked digital circuitry. If the switcher’s internal switching is synchronized to an external clock (which is done by some switchers by carrying this out through a terminal), the internal oscillator of the switcher transmits only during intervals when ripple or other noise is least helpful and affects filtering the least. This solution enables the switcher to sidestep the noisiest time period, like a boxer sidestepping punches. Since the external ripple filter on a switcher’s output forms a feedback loop to the regulator input, it is difficult to adjust the output filter to reduce ripple. Instabilities due to feedback magnitude and phase problems, undershoot, overshoot, response and hold-up characteristics are so dependent on the filter that only minimal adjustments can be made to minimize the ripple. Synchronization of the internal oscillator to transmit during the best intervals (to make filtering easier) appears to be a good solution.

Quasi-regulation for multi-output switchers fully regulates the main output, with other outputs keyed to it. If the load is reasonably invariant, this is adequate. Unfortunately, if line excursions are greater with widely varying loads, this will not suffice. A ±10% regulation, which is needed for most commercial ICs, may be exceeded in thermal drift and cross regulation. Before specifying such supplies, be sure to test the supply under the worst case input and loading conditions. If this proves satisfactory, such a lower-priced unit will save in overall system costs.

Switching and Linear Supplies Features

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<th>Feature</th>
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<tr>
<td>Number of package sizes</td>
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<td>Range of models</td>
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<td>UL, VDE, etc. listed</td>
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<tr>
<td>Commercial contract plan (for OEM/large-quantity purchasers)</td>
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<tr>
<td>Reliability (practical, not theoretical)</td>
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<td>Several levels of regulation</td>
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<td>Convection cooling (vs. external heat sinking or forced air)</td>
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<td>Efficiency</td>
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<td>Remote programming (on all models?)</td>
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<td>Mountable on 3 planes in any position</td>
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<td>Wide operating temperature range</td>
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<td>Automatic current-limiting and self-resetting protection</td>
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<td>Overvoltage protection</td>
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<td>Serviceability (all components replaceable? Easy to locate?)</td>
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<tr>
<td>Complete electrical isolation</td>
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<td>Meets military/environmental specs</td>
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specifying switchers? follow these steps.

Since switchers are more difficult to design and manufacture in-house than are linears, most OEMs specify switchers. Despite the wide variety of available switchers, many applications require modification of existing switchers or possibly custom designs. Rather than specifying a standard catalog switcher, designers specify a semi-customized unit. It is at this point that you may run into trouble. Like writing an article, writing a good specification requires that you begin with a specification outline or table of contents.
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writing a specification for a power supply, particularly a switcher, means you must take into account the intended application. If it is a switching-power supply, it must be particularly well-specified with limitations. Differences between the specification for a switcher and a linear supply would be primarily in the performance requirements (I/O specs). To prepare a specification, begin by preparing a specification outline or table of contents that includes these major categories: introduction, standards, performance (I/O specs), environmental requirements, acceptance tests, warranty and documentation. The last five are typically the same for both linear and switchers.

Sound confusing? If you’ve written specs before, you may think that writing spec for a semi-customized or customized supply is not that involved (and, relatively speaking, you are right). But, make one mistake, and your company will foot the bill for oodles of supplies good for boat anchors (not to mention your career). With this in mind, let’s look at one set of specifications, as suggested by a supply maker. It’s not the same for both linears and switchers.

Introduction is merely a brief statement which indicates how the supply will be used in your particular application. This statement will detail the type of equipment to be powered and provide details of the computer system, including the environment it will be expected to operate in and other conditions. Standards will include both those that are legal and must be met or other standards. To add extra standards — more than is necessary — will only add to the cost of the overall system. If intended for a system used in commercial applications, obviously the supply will be lower in cost than one intended to meet government or other regulatory agency standards. Overspecification is as dangerous and costly as underspecification. This is more true today than in the past and will be even more so in the future.

As for performance requirements that must be met, it is this section that will differ most from that when specifying linear supplies. This section’s performance requirements will be broken down into several categories. It will include input voltage range which will typically be around 115 V to 220 V; anything above 260 should be avoided because this is generally the switching transistors’ upper ratings.

In defining the frequency ranges of the input circuit, remember that they typically fall between 45 Hz and 400 Hz. The need for lower output frequencies is not so common, which is just as well because the capacitor input filter limits the input frequency. Whenever a source or power supply is placed across an uncharged capacitor, the capacitor will act as a short circuit, thus creating a transient current surge. Obviously, limiting is needed. Generally, this can be low-cost thermistor-type or step-start limiting. Thermistor limiting, though low in cost, cannot cool between a series of dropouts and recoveries. If repeated dropouts are an anticipated problem, forbid thermistor limiting and specify one of several alternatives. Do specify maximum acceptable inrush current, which is a function of the circuit breaker’s or fuse’s current trip rating. This may be determined from specification charts supplied by the manufacturer. As for output current and voltage ratings, the loads will set this. Decide what safety will be built in above this maximum. As for voltage regulation, and as discussed earlier, a regulated multiple-output switcher has a primary output with secondaries. The primary voltage is obtained from a pulse-width regulator. Load regulation will be ±0.1%. Secondaries are quasi-regulated or unregulated. If unregulated, they can vary,

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usually up to ±10% from nominal. It may be lower in cost. When specifying noise and ripple, the more you require a supply manufacturer to design in or semi-customize, the greater the switcher will cost. A reasonable tradeoff between noise and cost can be made if a one to two percent value is specified. Be sure to specify the test instrument bandwidth that will be used to measure this figure (typically dc to 10 MHz and 30 MHz). As for slower transient response, this is unavoidable; unity-gain frequency of the regulator must be lower than switching frequency. Do specify the magnitude of load-step change, how close the output must return to nominal in the specified time, and maximum overshoot resulting from a load-step change. As for holdup time, as mentioned earlier, this will depend primarily upon the rectifier-filter capacitor and typically may lie between 15 ms and 30 ms. If your application requires a longer holdup time, obviously, increased capacitance will be reflected in the cost.

As for ohm-per-voltage protection, this problem is not as serious with switchers as with linears, since in the case of switchers the opposite problem is more likely to happen. When a Schottky diode or switching transistor goes, it usually opens, thus either removing output voltage or greatly lowering it. If ohm-per-voltage protection is deemed necessary, pulse width modulator control circuitry may contain inherent electronic limiting to prevent this. On occasion, a switcher’s control feedback loop may open, resulting in a rapid rise in ohm per voltage. In a linear supply, failure of the series-pass transistor, usually due to a short, permits unreg-

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Figure 4: Holdover storage time, the length of time a switcher maintains full output after input power fails, varies: the greater the input voltage and the less load, the longer it is. The relationships are approximately linear.

ulated dc to pass through to the output. To prevent such high voltage from damaging the load, some form of low protection (such as an SCR crowbar circuit) will short the output to ground quickly enough to prevent damage.

Although these general guidelines for writing switching supply specifications may vary, why not contact several vendors to obtain sample specifications? By comparing them, and knowing your application needs, you can avoid making that one critical mistake that will fill your warehouse with useless supplies.

**purchase or build? beware of pitfalls**

For most uses, off-the-shelf supplies are sufficient. Unless you have in-house power supply expertise (particularly for switchers), or if the volume of systems warrants it, or if you are building up in-house expertise, it may pay to buy rather than build. With the engineering shortage, and with the growing complexity of supplies and the specialty of the field, the trend is definitely towards buying and not building your own. The cost per watt of off-the-shelf, custom and semi-custom switchers continues to improve. For a manufacturer lacking switching supply design expertise, it is unlikely that he can produce a supply in reasonable quantity that would be competitive; or, if he could, would feel comfortable doing so, knowing that the risk of failure is growing.

So did you decide to buy rather than go the "roll-your-own" route? If you think you've got it made, you're wrong. In buying a supply, the road is strewn with potholes. Confusing claims made by supply manufacturers compounded with suspiciously high values (particularly MTBFs), look-alike warranties, and other pitfalls insure that specifying a supply is not without its dangers.

Although there is no way to avoid risks, there are certain rules to follow to minimize dangers. Do not specify a power supply solely from spec sheets. If you are a programmer, or in any other way unqualified to compare computer supplies (particularly switchers), obtain the services of a knowledgeable engineer. Always visually examine and evaluate a supply. Be sure to remove cover plates, inspect for inspection dots, wiring, solder quality, connectors, PCB quality, and other visually obvious signs. When comparing MTBFs, calculated values are usually based on vendors' derating standards; therefore, they may be inadequate. If calculated against a recognizable standard, this will prove to be a baseline by which you may compare different supplies. Unfortunately, the real world doesn't work so well. Check
out the power supply manufacturer’s QC, his visual inspection of mechanical components (switcher’s solder joints, screw connections and so forth), full power burn-in and other procedures. Check the vendor’s reputation. Contact colleagues in your firm (or its divisions), or at other firms (who will return the favor one day). And be sure to obtain a list of customers. Remember: big isn’t always best; at least one major power supply manufacturer now provides less than satisfactory service.

Are those claims of immediate delivery really true? Do off-the-shelf supplies come within the three days, as claimed? Unfortunately, off-the-shelf supplies may not be available for eight or more weeks ARO. This is particularly true if a lower quantity is ordered. Other companies both small and large list supplies they do not have in stock or even in production — or sometimes not even on the drawing board! Of course, it is impractical to stock thousands of models, so it is expected that many are built on a “per order” basis. However, many off-the-shelf items are not.

If you specify a semi-custom supply and discover it must be returned, you will not receive return credit, nor credit for cancellations for supplies ordered in error. Even for off-the-shelf supplies, a restocking fee will be charged prior to return for credit.

As for terms, consider price and quantity discounts, export handling charges, financing, in-plant (source) inspection charges, anti-moisture fungus-resistant varnish coating charges and service charges. Examine serviceability of the supply. Replacement parts may not be as easy to obtain as you were led to believe, particularly for switchers.

As for warranties, warranty times do differ; and, in many cases, MTBFs may exceed the warranted term. Warranty periods may extend from one to five years, with encapsulated supplies, which are non-serviceable, running for far less (such as one year). Determine if the manufacturer includes a retest and inspection charge. Determine service facilities available and the reps in the area. Can you reproduce the technical data manual, technical data sheets or information for inclusion in your computer system technical manuals? This is the time to ask. And does the manufacturer provide applications assistance? What is his level of expertise? Examine qualifications. And, while examining specifications, beware of specsmanship. Qualifiers like “up to” and “greater than” are often more a representation of reality than the better values that they seem to indicate. (Or, this may indicate these values are too hard to measure).

If you are specifying a custom switcher or semi-custom supply, don’t over specify. A range that is specified as too broad, such as meeting transient responses under all input conditions (when the applications do not require it), only makes it more difficult for the manufacturer to meet those specifications. So, some manufacturers will take certain shortcuts to do so. Worse, this overspecification can do nothing but lower reliability and unnecessarily increase costs.

In considering power supplies, particularly switchers, it is more important today to consider company reputation than in the past. Reputation alone isn’t enough. Certain well-known firms may carry some categories of supplies merely as a convenience to customers, rather than specializing in those categories. Other well-known firms may semi-customize or customize power supplies for a certain category of users, such as aerospace or medical OEMs, and may find it more difficult to meet your intended application if it falls within, say, industrial or scientific fields. In any event, if you follow the above selection procedures, you will optimize your chances of selecting the best supply for your system.
Fame and fortune — yours for the asking. Ask about Smoke Signal Broadcasting’s powerful and flexible development systems with 64K RAM — called Scout-system™. Hardware and software in one complete, low-cost package.

Everything you expect and need for speedy application design/implementation for the entire family of 6800 Series microprocessors.

Example: There’s Scout’s exclusive Hunter™ shortcut debugger — handles assembler and disassembler lists in easy to understand mnemonics instead of time-consuming machine language.

Ask about Scout’s options: an in-circuit emulator to tie into your target system, 8” floppy drives expandable to 4 Mbytes or a hard disk drive.

There’s even the first octo-density drive development system for under $5,700.

Act now — ask for free details.

Send us this coupon now. We’ll send you our “Understanding Development Systems” product brief.

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Title __________________________
Company _______________________
Address _________________________
City ____________________________
State/Zip ________________________
Video Display Terminal Showcase

terminal manufacturers offer alphanumeric and graphic terminals

This showcase presents the latest in display technology from a variety of major manufacturers. Only the most recently introduced models appear here; each company sells a number of other models as well.

For inclusion in future display terminal showcases, write to: Showcase Editor, Digital Design, 1050 Commonwealth Ave, Boston, MA 02215.

Dialogue 80

Video Display Terminal. Capable of operating in either conversational or block mode. Non-glare 12" diagonal screen. Also non-glare detachable keyboard with 20 programmable function keys. Scrolling is standard. Self test program ROM, display, data RAM and loopback of serial interface.

Ampex Corp, (Memory Products Div), 200 N Nash Street, El Segundo, CA 90245. Circle 226

AND

A liquid crystal dot matrix display. Features 40 A/N characters in a two row, 20 character per row format. Each 5×7 dot matrix character is 0.21" high and is capable of displaying the full ASCII character set. Below each 5×7 dot matrix character, an additional row of dots has been provided for a cursor. Requires only a single 5VDC supply. Other models have 1 to 4 display rows.

A.N.D. Co, 770 Airport Boulevard, Burlingame, CA 94010. Circle 300

AJ 510

Interactive 15" Display Terminal. TTY compatible. 80 columns. Terminal status indicator allows user to see terminal presets in 81st column. Rear panel switches may be displayed on command. Cursor key transmission permits local or remote control. Preset tabs every 8 spaces with resetting on command. Typewriter style keyboard. Two RS232C connections, 80 characters/24 lines, 7×10 dot pattern in 9×12 matrix.

Anderson Jacobson, Inc, 521 Charcot Ave, San Jose, CA 95131. Circle 227

209001 Ambassador

15" screen. A/N stand-alone terminal. Keyboard attached. Raster technology. Selectable A/N display formats from 18 to 60 lines via keyboard or computer. 80 characters per line. Zoom and scroll control. Interface, RS232 standard; optional, RS449, 20mA. Height of character varies with display format. Readout color, P39 green. Also available, P4 white.

Ann Arbor Terminals, Inc, 6175 Jackson Rd., Ann Arbor, MI 48103. Circle 228
LPVT

Large Printer Video Terminal. TV-type monitor plus software produces high quality print of various sizes. The LPVT unit can be used with various black and white or color monitors, or can be attached to a standard TV unit. Unit can produce character sizes from 3/16" to 3" high. Useful for airports, loading terminals, visually impaired, etcetera.

ART Computer Products Inc, 80 Boylston St., Suite 1260, Boston, MA 02116

Circle 229

DC-946-30

5" CRT Data Display. Incorporates a new frame type and ultra reliable state of the art components. Has a plug-in circuit board, minimum geometric distortion, video response to 18 MHz. 650 lines of resolution. Internal controls for brightness and vertical/horizontal size, linearity and hold. Company has a line of data displays ranging in screen size from 5" to 15".

Audiotronics Corp, 7428 Bellaire Ave, N Hollywood, CA 91605

Circle 230

Consider graphic input devices, instruction set richness, software support packages, screen resolution, picture element resolution and host interfaces.

CC80

Graphics Work Station. 19" or 25" high resolution graphics CRT plus 9" A/N CRT. 240-position menu function keyboard plus record function keyboard plus standard graphics keyboard plus coordinate entry keyboard. Cursor control. A variety of digitizers. Communications processor (high speed communication multiplexer) can support up to 4 CC80 work stations.

Auto-trol Technology Corp, 12500 North Washington, Denver, CO 80233

Circle 231

BCX Series

CRT. Available in a frameless version. Unmounted display concept saves cost and facilitates incorporation into terminals. 12" diagonal. Single circuit board. All electronics included plus high-voltage assembly. Each display is fully aligned, adjusted and ready for installation. Specified line rates up to 19,400 Hz. High brightness display with high video channel bandwidth.

Ball Electronics, Display Div, PO Box 43376, St Paul, MN 55164

Circle 232

SM-810-002

Planar gas discharge (neon gas) display with microprocessor control. High brightness (75 foot lamberts.) Parallel ASCII input. Self test and scroll modes. 130° viewing angle. Single 5V supply. Single line, 20 characters (0.47" x 0.28") 5x7 dot matrix from 98 character set. A μC assembles characters and controls display. The display system can be interrogated concerning status (busy or ready).

Beckman Instruments, 350 N Hayden Rd, Scottsdale, AZ 85257

Circle 233

DM Series

New optional 15" monitor. Has a bonded anti-glare face plate with high resolution. P42 green monitor offers a high degree of character legibility and larger character size to alleviate operator fatigue. Beehive's DM series terminal includes its recently introduced IBM 3276 compatible control unit with display station.

Beehive International, 4910 Amelia Earhart Drive, Box 25668, Salt Lake City, UT 84125

Circle 234

TM 71 A/N Microterminal

Measures 8.5"x4.5"x0.6". Small compact device has 16 segment LED character display. 0.16" red LED 80 character buffer. Single line display. 80 ASCII characters, 14 function keys. Interfaces RS232C, 20 mA current
loop. This tiny terminal functions as console and control center for instruments and small systems. CPU control of flashing, scrolling or blinking.

**Burr-Brown Corp.** PO Box 11400, Tucson, AZ 85734

**Self Scan II**

Gas Plasma Display. Screen size 11"x6"x1½". OEM component. 60 lines/inch resolution. 75 Hz rate. Compatible with any host computer. Color readout: neon orange. Height of character 0.26". Burroughs has, or is about to announce, a new gas plasma technology. New unit will eliminate need for refresh electronics and will offer additional benefits to terminal mfrs.

**Burroughs OEM Marketing,** Burroughs Place, Detroit, MI 48232

**3100**

DEC-compatible video terminal. Emulates the DEC VT 100 with advanced video options. Has features which, according to company, are not available on the comparable DEC model. Costs less than the VT 100. OEM plus quantity discounts available. Has printer port, non-glare screen, four video attributes to set up prompt legends, 19,200 baud operation and screen save.

**Cobar Inc,** 1181 North Fountain Way, Anaheim, CA 92806

**MVI-7**

Color Graphic CRT Terminal. Colors include red, green, blue, white, yellow, turquoise and pink. Display has 1920 A/N characters in a 24 line × 80 column format with 720x288 graphic resolution. Graphic data can be displayed by using any position or all of 9x12 character matrix. Detached keyboard has 87 keys. Blink, highlight, foreground and background colors and underscore. Four independently addressable and scrollable split screens. Standard emulation package includes VT 100, VT 52, IBM 3101, Hazeltine 1500 and Lear Siegler ADM3.

**Colorgraphic Communications Corp.,** 2379 John Glenn Drive, Atlanta, GA 30341

**MB85-12**


**Comark Corp,** 257 Crescent St, Waltham, MA 02154

**Designer M**

Graphics processor with a fixed media disk and magnetic tape drive system. Has 2 "Instaview" raster scan interactive design work stations, a graphics operating system, a system console and a CAD/CAM software applications package. Three tasks (two interactive and one batch) can be supported simultaneously by system.

**Computervision Corp,** 201 Burlington Rd, Bedford, MA 01730

**Model 2400**

High resolution monochrome display monitor. 19". Wideband video amplifier, pre-set calibration controls, dynamic focus, optional CRT phosphors, adjustable horizontal scan frequency. Available in cabinet, naked or rack-slide versions.

**Conrac Div, of Conrac Corporation,** 600 North Rimsdale Ave, Covina, CA 91722

The display terminal market, for both high- and low-end terminals, will show greater growth than projected.
Color graphics provide wider ranges of options from single on-board processors to complete systems.

**CPG 100**

Graphics terminal operates in 11 modes to permit use for graphics memory. A/N or independent use of either without affecting the other. Compatible with the industry standard Tektronix Plot 10 software, it is also compatible with ISSCO's DISSPLA and TELLEGRAF and offers enhanced graphics input. The CPG-100 allows for full scale usage with a 640 \times 480 resolution on a green-toned raster screen and a large addressable plot area of 1024 \times 780 dots. Selection of 4 character sizes, dot-dashed lines, selective erase and A/N overlays are all standard.

*Continental Resources Inc., 175 Middlesex Tpke, Bedford, MA 01730*  
*Circle 242*

**CTI 2000**

Display terminal. 12". Provides 3270-type features and application-program access to IBM 2740 and 3767-type keyboard printer terminals. A slave printer may be attached to the display to print data selectively from a screen. 24 lines, 80 characters. 25th line for operator use.

*Custom Terminals Inc, Box 19006, Raleigh, NC 27619*  
*Circle 221*

**Dash G300**

Graphics Display Terminal. Two modes of graphic operation are selectable: abbreviated command mode; mnemonic command mode. Two user selectable scroll rates. 12" tilt and swivel screen displays. 1920 characters in 24 lines, 80 columns. Graphic images are plotted on a 640 \times 240 pixel matrix. Detached keyboard has a typewriter style arrangement; 14-key numeric pad; 15 program function keys; 5 local function selection keys.

*Data General, Rte 9, Westboro, MA 01581*  
*Circle 243*

**132-2**

Stand alone, 12" diagonal screen. Green phosphor (P-31). Has an integral keyboard. A/N, no graphics. "Charactron" technology. (Dual deflection CRT. Beam deflected through stencil cutout and then to screen.) Resolution: 4000 lines, 60 Hz refresh. Compatible with all asynchronous (ASCII) computers. RS 232C, (20 mA current) 0.09" character. 115V or 230V.

*Datagraphix, Inc, 10981 San Diego Mission Road, San Diego, CA 92108*  
*Circle 244*

**DT 80/3**


*Datamedia Corp., 7401 Central Highway, Pennsauken, NJ 08109*  
*Circle 245*

**DTH-15**

CRT Data Display. Available in kit form as well as in a compact and rugged frame. Mounted on a single PC board including the HV flyback assembly. The 110° deflection CRT can be ordered in different phosphor types and with a polished, direct etched or laminated faceplate. Compatible with Motorola and Ball 110' models. Competitively priced.

*Datronix Inc, 160 First St SE, New Brighton, MN 55112*  
*Circle 246*

**D148C**

Graphics System. Creates high resolution 35mm slides. Unit creates a full range of computer-oriented business graphics and presentation quality slides quickly, easily and at a low cost.

*Digitoid Corporation, 9700 Newton Ave., Minneapolis, MN 55431*  
*Circle 225*
GIGI

General Imaging Generator and Interpreter. Low cost text and graphics terminal with built in features of graphics intelligence and special applications software. Aimed at educational institutions. Accesses Digital's powerful educational computers. Portable modular keyboard. Multiple color for display (8) with 8 shades of gray. Multiple character sets (24 rows of 84 characters each.)

Digital Equipment Corp, Education Computer Systems, 129 Parker Street, Maynard, MA 01754 Circle 247

VT100

Video Terminal. A high performance video display that provides maximum flexibility and portability. Operator-oriented features include double-width/double-size characters, 80 and 132 column lines, a detachable keyboard, smooth scrolling, a split-screen and composite video output. 7×9 dot matrix characters with 2 dot descendents in 24 lines. Character set: 94-character ASCII and 32 special graphic features. Baud rates from 50 to 19200. Options include advanced video, printer port, a 20mA interface, foreign language and special character sets.

Digital Equipment Corp. (Terminal Product Group) One Iron Way, Marlboro, MA 01752 Circle 223

VT-640

Retro-Graphic enhancement for the DEC VT100 terminal (Converts the VT100 A/N terminal to a graphic capability). Display screen: 8×6. Graphics terminal with A/N ability. 640×480 resolution; vector drawing; point plotting; selective erase; A/N overlay. Interface: EIA RS-232C. 34 lines displayed, 80 characters per line. Operating power: 90-128 V, 180-256V. Switch selectable.

Digital Engineering Inc., 630 Bercut Dr, Sacramento, CA 95874 Circle 248

VP 828

Video Display Terminal. Customized features: bidirectional scrolling, three scroll rates, eight video intensity levels. User can also select page or line transmission, block or character transmission and the start and end of blocks. 80 or 132 columns. Split and reverse screen, blink, underscore. Non-volatile RAM, separate transmit and receive.

Direct Inc, 1279 Lawrence Station Road, Sunnyvale, CA 94086 Circle 249

CD-33

A new series of BARCO compact color display monitors is offered by Elector, US distributors of BARCO displays. This model offers a color-critical, high resolution PIL tube which, claims the company, lowers costs and eliminates the need for operator convergence and adjustments. Unit has a high resolution .31 mm dotted screen shadow mask in-line gun picture tube permitting sharp definition of characters or graphics. Rack mounted or desk-top display.

Elector, 5128 Calle del Sol, Santa Clara, CA 95050 Circle 250

4430 CRT Terminal

Ergonomically designed with green non-glare display. A/N asynchronous ASCII microcomputer based terminal. Fully compatible with the DEC VT100. Has a detached low profile keyboard, tiltable screen, a printer port, format control and smooth scrolling.

Facit, Inc., 66 Field Point Rd, Greenwich, CT 06830 Circle 251

Increased intelligence frees terminals from dependence upon the host computer, if the graphics display is simple.
IM-1

Graphics terminal. Has a basic interface using full RS-232C I/O port. Universally compatible. Interfaces to most minis and micros (Alpha Micro, LSI-11, etc.). Software allows interactive XY plotting, 3-D contour plotting and pie charts. High quality images.

Form and Substance, Inc, (c/o DP Design) 3375 Vinton Ave, #3, Los Angeles, CA 90034

Vuepoint

An A/N display panel, touch sensitive scanner. Microprocessor controlled, communications interfaced. Up to 240 touch-sensitive areas. Interface: RS 232. 12 lines x 40 character flat panel display can be hung on wall, attached to an industrial control panel or pedestal mounted. Small: 12"x9"x3" for display; 12"x9"x6" for controller. Lightweight, portable (display can be placed 10' from controller.) Optional keyboard and printer interface. Automatic screen refresh.

General Digital Corp, 700 Burnside Ave, E Hartford, CT 06108

GT-110

Stand alone. 12" screen. P4 or P31 color readout. Sold with keyboard. A/N. Raster technology. 50/60 Hz refresh. 24 display lines; 80 characters per line. 0.2" height of character. Operating power: 110/60Hz or 220/50Hz. It has a line or block graphic capability and is ASCII compatible.

General Terminal Corp, 14831 Franklin Ave, Tustin, CA 92680

G-1000

High resolution, low cost monochrome graphic terminal with an A/N overlay option. Z-8001 based, self contained unit. Useful as a programmable terminal in any application requiring high resolution and interactive capability. A/N data is stored in that portion of the memory plane not required by the bit-mapped 1024 x 792 graphics image. No additional memory required. AOC card is field installed by user.

Genisco Computer Corp, 3545 Cadillac Ave, Costa Mesa, CA 92626.

9278-12

CRT. Supports screen size of 1,920 characters. 15" screen. Automatically adjusts from a 1,920 character screen to a 3,440 character screen depending on application. Uses full display area in all applications. Compatible with IBM's 3270 product line. Has detachable 75-key keyboard. Three intensity levels. 25th status line.

Harris Corporation, Data Communications Division, 16001 Dallas Pkwy, Dallas, TX 75240

Executive 80, Models 21/30


Hazeltine Corp, Commack, NY 11725

HMW 9001

Interactive Graphics Terminal. A self-contained ASCII compatible color graphics color terminal intended for process control, network management, financial analysis and computer-aided design. "This compact unit may be desk mounted and may replace most A/N terminals," says company. Dual 8085 processors. Eight foreground and background colors. 80 x 48 character format. 512 x 256 repeat field graphics format. Full edit and communications.

HMW Enterprises, Inc, 604 Salem Rd, Etters, PA 17319

Display resolution is determined mostly by dimensional mathematics.
Concept 108
Display terminal. 80/132 column display, non-volatile memory, 8 pages of display memory, and a series of user-specified functions. 5×9 dot matrix in a 7×10 dot array. The 8 pages of display memory is allocatable between display memory and function key storage. "Create screen" function transmits a complete format.

Human Designed Systems, Inc, 3700 Market St, Philadelphia, PA 19104

ED-7128
Small, solid-state flat panel E1 display made by Sharp Corp. Provides 80 characters per line and up to 12 lines of A/N information. Graphic portrayal possible on the 128×512 full field array. Display panel is 1.77"×7.1". The entire assembly weighs approximately 0.5 pounds. The 72.5 LPI resolution is flicker free.

Hycom Inc, 16841 Armstrong Ave, Irvine, CA 92714

ID 100
Video Color-Symbol Graphics Terminal. 12" display. Serial Communications. ASCII terminal. Portrays 8-color (background or foreground) character and symbol graphic images. A high performance color-replacement (80 characters per line) for DEC’s VT 100 B&W display terminal. High resolution. With keyboard. 24 lines displayed (80 or 132 characters) 5×7 or 7×9 ulc ASCII symbols plus special control symbols (128 total.)

ID Systems, 4789 Rings Rd, Dublin, OH 43017

RDS 3000

Ikonas Graphics Systems Inc., 531 Pylon Drive, Raleigh, NC 27606

3600-21-020
A microprocessor controlled compact A/N vacuum fluorescent display. Can be mounted in minimum panel area. Full 96-character ASCII set plus European ECMA-7 overlay characters. 5×7 dot matrix (20 displayable characters) are bright blue-green color, filterable to blue, green, aqua or yellow. 150° viewing angle.

Industrial Electronics Engineers, Inc, 7740 Lemona Ave, Van Nuys, CA 91405

Replacement terminals offer display enhancements, more flexible printing terminals and choice of screen sizes.

Model 401

Informer Inc, PO Box 91054, Los Angeles, CA 90009

High Resolution Flicker-Free Display
System features dual 19" raster screens; one color, one monochromatic. Resolution of 1280 × 1024 pixels. Each screen can display full 2- and 3- dimensional graphics, plus operator prompts and messages with independent hardware pan, zoom and drag for both screens. 8 color from palette of 4096 usable colors.

Integraph Corp, One Madison Industrial Park, Huntsville, AL 35807.
Color graphics terminals add a degree of interactive independence to the display station.

TK-242

Touch-sensitive add-on kit for use with Lear Siegler Model ADM-42 CRT Terminal. Provides the video display with a human interface that is easy to use. Data entry is made by touching the finger to display on the CRT screen. The touch-sensitive faceplate is placed over the CRT Monitor. The electronics board is mounted inside the CRT monitor housing. Interconnecting cables and mounting clamps are supplied with the kit. Offered for either parallel or serial interface.

The Emulator

Video Display Terminal. 12" diagonal screen. Stand alone with keyboard. P4 Phosphor. Non-glare screen. Memory size: 24 lines × 80 characters per line. All 128 ulc ASCII characters, 11 special character symbols, 8×10 character field; 8×8 character matrix. Light character on dark background; reversible. Interface, RS 232C operates at 15 keyboard selectable baud rates 50 to 9600 bps.

ADM 31

Intermediate Terminal Video Display. Has programmable function keys, 25th line for terminal status, smooth scroll, X-on and X-off, cursor on/off and horizontal split screen. Blink, blank, underline, reduce intensity, reverse fields and business graphics. 12" diagonal CRT. 25 lines of 80 characters ulc.

Lexiscope 4000

Video Display Controller. Graphics plus A/N capability. Emulates standard A/N display terminal and provides moderately high resolution display. Display with only A/N can have graphics capability with this board. Plugs directly into one slot in a Nova or Eclipse mainframe. Also emulates graphic commands of an HP 2648A terminal. Graphic resolution 560×500. 256 byte FIFO buffer. 96 ASCII ulc characters set plus 32 special pseudographics symbols.

Hypergraf 2600

Interactive Graphics Terminal. Uses: CAD/CAM, mapping, mechanical design, piping. Stroke writer display. Dimensions: 52"×50"×44". 115VAC, 60 Hz (50 Hz available.) Power description 1.6 KW. Heat 5500 BTU/hr. Recommended for those applications that place an inordinate demand on mainframe.

Orion-60

512 × 512 Plasma Display. Standalone 96 symbol character set. A/N and graphics. Has touch panel as an option. The plasma display offers a non-refreshed storage for a bright high contrast flicker-free presentation. Selective erase for any point character or vector. Full 96 symbol ASCII character set plus a programmable character set with 128 symbols. Transparent plasma display may
be viewed in combination with projections from 35 mm projector.

**Magnavox Govt and Industrial Electronics Co.**, 1313 Production Rd, Fort Wayne, IN 46808

**CTM 300**

Serially interfaced (RS-232C) ASCII terminal with 8-color CRT display, 80 characters by 25 lines. Detachable typewriter format keyboard plus 18 user definable keys, color monitor has high color clarity and resolution (0.3 mm dot pitch.) Deliveries of new CRT and keyboard were scheduled to begin in July.

**Matrox Electronic Systems Ltd**, 5800 Andover Ave, TMR Quebec, H4T 1H4 Canada.

**32-Character Display Module**

Vacuum fluorescence features oversize characters in soft green light for improved readability and prevention of eye strain. Fully compatible with ASCII and Baudot code. Single 5 V power source. Characters are 0.21" high by 0.12" wide. 32 A/N per line plus an additional 8 character "wraparound" in a 40 character buffer. Switch-selectable display can move 1 to r or r to 1. Full 96 character set including all symbols and letters, all upper case.

**Micon Industries East**, 8 Blanchard Road, Burlington, MA 01803

**V-2000**

Video Display Terminal. The terminal incorporates a 12" non-glare screen with detached keyboard for operator preference-location. Reverse video, flashing, underline and half-intensity. Has 12 control keys, a separate numeric key pad, printer interface, two pages of memory and 20 programmable functions.

**Micro Five**, 17791 Sky Park Circle, Irvine, CA 92714

**LD 2650**

Alphanumeric LED Flat Panel Smart Terminal. Displays 16 characters, 2.3" in height in either amber or red LED. Overall dimensions of display unit are 6"H x 3"L and 2.5"D. The unit is designed for large group viewing. It has both an RS-232 and tape storage ports. UL plug-in transformer mass storage unit. Repairs facilitated by permitting PC board exchange.

**MIM Co.**, (Modern Information Methods), 2860 Bay Rd, Redwood City, CA 94063

**ST 2019/LBW2**

Black matrix with a phosphor screen of red, green and white for A/N display. Has a dot trio spacing of 0.31 mm. This series uses a combination of a superfine-pitch shadow mask and a superhigh-precision electron gun. Offers a resolution double that of color-tv CRTs. More than 6000 characters can be displayed. Has a high quality color-character and color-graphic display.

**Mitsubishi Electronics America Ltd**, 2200 West Artesis Blvd, Compton, CA 90220

**DM 256 X 64A**

A complete display panel consisting of 16,384 fluorescent 0.4mm square dots arranged in a 256 vertical-rows and 64 horizontal-rows configuration. Fills an area 166mm x 41mm (approx.) Bright, high resolution, dot matrix images obtained. Size of screen is 2½ times image width previously available in continuous dot fluorescent display units.

**Noritake Electronics Inc**, 22410 Hawthorne Blvd, Torrance, CA 90505

**Alphanumeric terminal costs continue dropping while intelligence increases.**
VCG-QT
Graphic Display Terminal. Provides 512 x 512 monochrome (or 512 x 640 x 3 color dot resolution) interface included for DEC LSI-11/2 and 11/23 providing direct, high-speed access to all dot positions on the CRT screen. Monochrome version is also available with parallel character memory for combined rapid update A/N and graphics display. 13" screen, 32 lines displayed.

Peritek Corp, 3014 Lake Shore Avenue, Oakland, CA 94610
Circle 276

New CRT Tube
19" high resolution (Delta type electron gun assembly). Provides high brightness levels and small sharp detail. Produces 80 easy-to-read characters per line (48 lines). Features very dense triad phosphor/dot screen and a new high density aperture mask which eliminates dot patterns visible on conventional TV tubes.

Philips ECG Inc., 100 First Ave, Waltham, MA 02154
Circle 277

PT-100
Data Terminal 12" Screen with Detachable Keyboard. For A/N plus line graphics. Resolution: 240 lines at 50/60 Hz. 24 lines displayed, 80 or 132 columns. Height of character, 0.132" x 0.078". Readout color: white or amber. Fully compatible with DEC VT 100. RS 232 or 20 mA interface. Keyboard baud rate 50 to 19,200.

Plessey Peripheral Systems, 17466 Daimler Ave, Irvine, CA 92714
Circle 278

PE 7902
Single-board LCD Driver. Drives LCD 5x8 dot matrix display systems. Activates 40 columns or 8 A/N graphic display. Five-voltage-level LCD multiplexing schemes are employed for optimum display performance. Voltage levels can be adjusted by input ports. Contains an on-chip 8 row x 40 column bit map. RAM for storage of display information. Only a single 9v battery is required.

Polychore Electronics, 1107 Tourmaline Drive, Newbury Park, CA 91320
Circle 279

4276
Stand Alone A/N Display Terminal. 15" screen with attached keyboard. High resolution (525 lines per frame) raster display, non-glare screen. Compatible with IBM 3276. Interface RS232C. Readout green phosphor, 24 lines, 80 characters (0.125" high) per line. 25th line for operator information.

Racal-Milgo, Computer Products Division, 6250 NW 27th Way, Ft. Lauderdale, FL 33309
Circle 280

ZMS-50

RCA Service Co, (Div of RCA) Bldg 204-2, Camden, NJ 08101
Circle 281

Rastergraf
High Resolution, Flicker-free Display. Resolution: 1000 x 1000 pixels. Screen sizes up to 25". DMA transfer rate to the raster scan display is up to 1 MB/sec. Vector drawing time is typically 3 microsec/pixel. This speed produces almost instantaneous updating of display. Great image brightness; interactive modification response time. 64 special function keys. System: Z80A microprocessor with 176 KB RAM memory, drum plotter, plasma display, desk and software.

Sigma Design West Ltd, 7306 S Alton Way, Englewood, CO 80112.
Circle 282

Various methods of displaying characters determine least costly approaches.
IQ140


Soroc Technology, 165 Freedom Ave., Anaheim CA 92801

Circle 283

Eyeecom II 109


Spatial Data Systems, PO Box 978, 508 S Fairview Ave., Goleta, CA 93017

Circle 284

UTS 40

Communication Terminal A/N. 12" CRT display. Attached keyboard. Raster technology. Scanning. Horizontal frequency of 22.2 KHz. Resolution 9x14 dot matrix over 80 columns, 25 lines. Input source: keyboard, communication I/F or direct CPU connect. Interface RS232. Compatible with Sperry Univac computer. Height of characters, 3.9 mm, width 2.4 mm.

Sperry Univac, PO Box 500, Blue Bell, PA 19424

Circle 285

132/15 Editing Terminal

15" non-glare screen with green phosphor, 25 lines by 80 or 132 characters including 24 data lines, 1 blank and 2 for status and prompting. ASCII 7x11 dot matrix with true descenders in a 9x14 or 9x16 dot cell. Horizontal scroll. Bold, blink underline, reverse video, double height, double width. Selectable dark or light backgrounds. 30 graphic characters.

Tab Products Co., 1451 California Ave, Palo Alto, CA 94304

Circle 286

VMT-2000 Videomate

Computer Data Display and a high resolution video raster scan display in the same unit. Displays documents, graphics, computer generated A/N and word processing images. Data display is produced by a companion keyboard and character generator. 3.8 million bit digital memory. Image memory output is 140 megabit rate for high resolution, flicker-free image. 8½" x 11" screen. Display resolution 200 dots/inch.

TDC (Terminal Data Corp), 21221 Oxnard St, Woodland Hills, CA 91367

Circle 287

4114

Computer Display Terminal. 19" DVST with powerful local intelligent graphics terminals. Host-based computer has vast processing power. Has capability for locally retained picture segments. MOVE and DRAW commands can be defined then stored, recalled and manipulated locally. Has new fast repaint feature and a definable, refreshed dialog area.

Tektronix Inc, PO Box 500, Beaverton, OR 97077

Circle 288

100-RO


Soroc Technology, 165 Freedom Ave., Anaheim CA 92801

Circle 283
The "settling in" of functions and features has taken place; product differences are less of a factor today.

Double height characters and double width. 40W operating power.

Teleray, Div. of Research Inc, Box 24064, Minneapolis, MN 55424

Circle 289

276/SDLC

Eight Station Display Control Unit. A/N. Functionally compatible with the IBM 3276 counterpart. Control unit serves 8 printers and display stations. Non-glare, smear resistant screen. Flicker-free. High resolution 9x14 dot matrix. Typamatic repeating keys, keyboard clicker, numeric pad, single key clear. Operates at 50° to 150° F. Heat dissipation: 502 BTU/Hr. 15" display screen. Raster technology. 24 display lines, 80 green or white characters.

Telex Computer Products, Inc, 6422 East 41st St., Tulsa, OK 74135

Circle 290

TSD Display Products, Inc, 350 Orville Drive, Bohemia, NY 11716

Circle 293

Perq

High Resolution Graphics Display. Single user workstation 15" screen. System sold with keyboard. Raster technology: 768 x 1024. 1 bit/pixel, 60 Hz. Non-interlaced. Tablet input source 66 display lines (80 characters per line.) with white readout. Height of characters is user specified as is width.

Three Rivers Computer Corp, 720 Gross Street, Pittsburgh, PA 15224

Circle 292

NDC 120

CRT Display Monitor. Video bandwidth 25 MHz. High linearity. Uniform focus characteristics across entire screen. Horizontal retrace time is less than 7 microseconds. Compatible with Bell and Motorola monitors. Special designed PC board provides highest performance levels. Separated horizontal drive, vertical drive, video-size inputs. MTBF 10,000 hours. P4 phosphor is standard. Options are P31 and P39.

TSD Display Products, Inc, 350 Orville Drive, Bohemia, NY 11716

Circle 293

Graphics-80

Intelligent Terminal. High resolution on large 21" display. Stand alone with keyboard. Primary use: graphics, uses stroke technology. Resolution 4096 x 4096. 2D clip, rotate, translate; 3D is optional. Serial or parallel interfaces. 80 line readout, 64 characters per line. Height of letters is scalable. Readout colors, P39 green, P40, P4, white.

Vector Automation, Village of Cross Keys, Baltimore, MD 21210

Circle 294

Visual 400


Visual Technology Inc, Railroad Ave., Andover, MA 01810

Circle 295
VG 8250

Graphics Display System for CAD/CAM applications. Emulates IBM's 2250 Display. Further, includes features of IBM's 3250 system. System easy to use with reduced operator fatigue. Built in diagnostics reduce idle time. Channel speed up to 1.2 MB/sec. System designed with small number of components.

Vector General, 21300 Oxnard St, Woodland Hills, CA 91367

VC 404

TTY Compatible Data Terminals. Low cost. Detachable keyboard. 1920 characters. Quiet and fast. Keyboard reliability, auto repeat, switch selectable, uic characters, complete cursor control key cluster. Optional numeric pad and function keys, APL character set, bidirectional serial peripheral interface. 12" non-glares screen. Green or amber display screen.

Volker-Craig Inc., 333 Metro Park, Rochester, NY 14623

1955

OEM Display Scope. Open frame 9" CRT. Magnetic deflection for improved point-by-point image construction. Used for displays in automobile testing, real-time spectrum analyzers, NC systems, flow monitors and medical electronics. Vertical bandwidth DC to 15 KHz.

Wavetek Indiana, 5808 Churchman, PO Box 190, Beech Grove, IN 46107

4815


Xycom Inc, PO Box 984, Ann Arbor, MI 48106

What’s Coming Up

Articles in the September issue of Digital Design will cover...

Computer Compatible Add-In/Add-On Memory

This focus on memory boards and boxes for system builders and integrators will examine how the changing market will affect the OEM in terms of shorter lead times, costs and access times as well as supposedly compatible boards and other pitfalls that system designers must be aware of when specifying such memory systems.

Here, in a nutshell, is a preview of things that we will cover. Independents are out of the vise that IBM's aggressive price-cutting put them in starting in late 1979. A few folded, others survived, and some finally prospered. Semiconductor makers, however, have grown more than expected, emerging as a dominant force in this market. Competition is fierce, and margins are small. The partials debate has subsided, and should be non-existent as we reach the mass markets with the 64-K RAMs. Much delayed, partly because of problems in going to a single SY-source, 64-K RAMs stumbled on the way to market; and, it looks like the Japanese will take this round. They should establish a share of market, maintain it, and will emerge as a more potent force in the add-in/add-on memory market.

Designing Answer/Originate Modems With Off-The-Shelf Components

This article will describe how to build a sophisticated modem with standard components with little or no adjustment. Designers building their own modems can find it a trying experience, particularly if they lack communications experience. It need not be so: here is how to design answer/originate modems by using standard, off-the-shelf components. Electronic engineers proficient at designing with microprocessors, PLAs, digital logic ICs and the like generally lack understanding of the analog side. This works against them in certain design situations, such as designing an answer/originate to connect a multiplexer from a remote outlet to the interface device.

Designing With Dot Matrix Printers

Low-cost computers, CRTs and communications demand low-cost hard-copy output for numerous applications. This article discusses some of the basic specification concerns of engineers encountering such application needs. Although slanted a bit to the low-cost printers used in portable terminals, desktop computers and the like, much of the selection criteria are valid for larger printers.

At the moment, the Japanese are attacking this low-end of the printer market, although Centronics, for one, should have the volume to persevere in this low-profit-margin, high-volume market — once it assimilates its on-going organizational changes and successfully challenges the Daisywheel with its upcoming printers. Daisywheels will continue to drop.
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This exposition is dedicated to the proposition that the unprecedented growth and expansion in the use of computers for all kinds of applications will continue at an exponential rate. No one company can solve everyone’s applications problems; no one company can supply everyone’s needs for complete systems, add-ons, peripherals and software.

Building around the central processing unit, the OEMs, the systems integrators, the turn-key houses and the sophisticated large volume end users will continue to use compatible computer equipment to devise special systems to solve applications problems with greater versatility and flexibility.

IF YOU ARE a buyer and specifier of plug-in electronics and appropriate software, you have a need to know about currently available products you can design into your systems as well as future trends in the state-of-the-art. THIS EXPOSITION GIVES IT TO YOU.

PRODUCED BY:

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Computers • Peripherals • Systems

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DIGITAL DESIGN'S REGISTRATION FORM
VISITOR'S APPLICATION FORM
COMPAT '81 Fills Information Vacuum

Why a Compat show at this point in time? To answer this question, we must go back a few years, back to 1970 and the introduction of the now-famous PDP-11 minicomputer by Digital Equipment Corporation — almost singlehandedly responsible for today's burgeoning independent peripheral industry. To be sure, independent peripheral suppliers did exist prior to the debut of the PDP-11; however, these manufacturers were concentrated solely in the large mainframe area supplying equipment for the IBMs and Univacs. This was a tough nut to crack for new entrepreneurs without the megabucks behind them so necessary to launch a new product. Not so in the minicomputer area.

A resourceful entrepreneur could break into the independent mini-peripheral market with a minimum of capital, and many did just that. To systems designers and end users, this was like opening a door to a whole new world. They were no longer locked into one manufacturer, but were free to seek other alternatives in the marketplace. For a time, it seemed like everyone and his brother was starting up a company to offer independent equipment compatible with DEC CPUs. DEC, for its part, gave the industry an even further push by concentrating so hard on the production of the CPUs, that it all but ignored the peripheral area. Before too long, the market was inundated with peripherals and add-ons; but with the respectable suppliers also came the rip-offs, the fly-by-nights, and the mom and pop garage operations. The result of all this activity: confusion on the part of the systems designer — confusion that still exists to this day.

Clearly, the process of system design — choosing a CPU from one vendor, terminals from another, disk drivers from yet another, etc. — has one overriding problem: How can a systems designer or large volume end user make an informed decision concerning product selection when he may not be aware of everything available to him? To make a choice without knowing all the facts, all the options open, and all the possibilities, is obviously unwise. To not be aware of potential problems, such as product reliability and failure to deliver on time, is equally foolhardy.

It came to the attention of the magazine's staff that there was a growing need for a central source to which designers could refer when considering memories, peripherals, add-ons, etc. Many of our readers reported that they relied on the ads in our magazine as a major source of information on compatible computer products and services. Some said that they saved every back issue, while others indicated that they had started a crude filing system comprised of ads torn from the magazine.

To help alleviate this information void, Digital Design published its DEC Compatible Directory (See DD January '81). The response to this directory was greater than ever anticipated, and led the directors of the Benwill Conference Group to believe that the time was now ripe for a trade show and seminar program geared to the needs of the buyer/specifier of compatible computer products (both mini and micro). Thus, COMPAT '81 was launched . . . some ten-plus years after the introduction of the PDP-11 . . . the first national trade show to ever exclusively address this segment of the computer industry.

Vendors Show Plug-Compatible Products

The list of exhibitors planning to show their wares at Compat is an impressive one, and covers every area in the realm of compatible computer products and services. Buyers and specifiers of these products — including OEMs, systems integrators, turnkey houses, large volume end users, and software houses — will find company representatives eager to help Compat attendees assess their current design needs, and to evaluate the equipment now available for integration into their computer systems.

Compat will be a one-stop shopping center for compatible computer products: Attendees will be able to see what's out there in the marketplace; to learn how existing products may be implemented to solve specific computer application problems; to compare price and performance figures; and, to
Digi-power has all the power you’ll ever need in OEM power supplies.

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The 50 watt DU50 unit is 4.25" x 7.75" x 2" height; the 250 watt DU250 Series is 4.7" x 12.25 x 2.45" height. Custom designs are available for OEM customers requiring special electrical, mechanical or physical parameters. A staff of service personnel and off-the-shelf replacement parts can be readily accessed should the need arise. Call or write for informative booklet and specification sheets.

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“talk shop” with people attuned to their needs and interests. Armed with this knowledge, Compat attendees will be able to make their buying decisions easily and with confidence.

Many of the products to be on display are unique; others will be getting their first public exposure prior to national marketing in the Fall. Here’s just a brief rundown on the type of hardware and software to be seen on exhibit:

- Controllers that provide compatibility between peripherals and CPUs marketed by major manufacturers. Also, networking controllers for data communications applications.
- Peripherals including printers, plotters, alphanumeric and graphic terminals, Winchester drives, floppy disks, cartridge drives, mag tape, backup storage, speech I/O devices, telecommunications devices, and add-on memories suitable for operation with major manufacturers’ CPUs.
- Accessories such as data links, backplanes, PROM boards, cabinets, A/D and D/A converters, telecommunications panels, cables, modems, and power supplies.
- Software packages that can run on major manufacturers’ CPUs.

COMPAT ’81 Exhibitors

The following is our list of COMPAT ’81 exhibitors as of press time; more are joining every day.

ABLE COMPUTER
Products: Bus links, multiplexers, extender boards.

ADAC
Products: Model 1816 CMOS 16K memory boards, featuring on-board battery back-up complete with charging circuitry.

ADVANCED ELECTRONICS DESIGN, INC.
Products: Wine-08 Winchester disk drives, AED 512 full color graphics display terminals.

AMLYN CORPORATION
Products: Models 5850 and A506 mini floppy disk drives, compatible with Shugart SA 850 floppy drive and Seagate ST 506 Winchester disk drive.

AUGAT

AUTOMATED CONTROL SYSTEMS
Products: Wang compatible printers, memory, terminals.

CII HONEYWELL BULL
Product: DSS-L100 — a new line of high-reliability, low maintenance cartridge disk drive systems.

CODATA
Product: UNIX-like operating system.

COMPOWER
Products: High reliability, switching power supplies. Model OL 25/50, a new design, is compatible with Boschert OL 25, yet offers twice the power (50 watts). Compact, high efficiency, and including protection circuitry. Other models: QL 50/65, OL 65/100, OL 130/150.

CRAIG DATA CABLE CO.
Products: Interface cable assemblies.

CUSTOM SYSTEMS, INC
Products: Model 420 16 channel programmable terminal interface. Additional offerings: controllers and peripheral interfaces for DG minis, including line printers, Qty. muxes, tape and disk controllers, memory control.

DATACUBE
Products: Color video graphics, alphanumeric character controllers, video processors for image processing and pattern recognition applications, memory products. Also produces multibus and Q bus compatible products.

DATAFLUX CORPORATION
Product: Winchester disk drive system.

DATA SYSTEMS SERVICES
Product: Disk systems.

DIGITAL ASSOCIATES

DIGITAL MICROSYSTEMS, INC.
Products: HiNet microcomputer network offering high speed local processing and shared disk storage in multi-user systems. Currently supports up to 32 users and is designed to address 255. Single-board system means improved reliability and easier maintenance.

DIGITAL PATHWAYS, INC.
Products: Controllers, voice synthesizers.

DIRECT, INC.
Product: Models VP825, VP828, and VP800 series terminals to be featured. All units offer fold-up, detachable keyboard, and up to 32K of display memory. VP828 and VP825 are compatible with H-P VIEW/3000 screen management system.

DISTRIBUTED COMPUTER SYSTEMS
Products: Models DCS/80 and DCS/86 Industrial Development and Control Systems. Based on either 8080 or 8086 CPU, and including disk controller, two 8" disk drives, 64K RAM, and 9 slot multibus backplane in a high-quality industrial case.

EMULEX CORPORATION
Product: Controllers.

EMULOG, INC
Products: Log-53 terminals, compatible with DG 6053/6052, D200, D100.

INTERNATIONAL DATA SERVICES (IDS)
Products: New system to be compatible with all DEC PDP-11 and VAX systems. Also: PDP-11/44 and VAX 750 with UNIX operating system.

INTERPHASE CORPORATION
Products: Multibus peripheral controllers for disk drives, including hard disk, cartridge, SMD, and ANSI interfaces. Also: video boards and subsystems.

INTERSIL, INC
Products: Memory for minicomputers, std bus products.

MAGNETIC RECOVERY TECHNOLOGISTS
Products: Tridensity 6250 BPI mag tape head and tape head drives. Tridensity 6250 compatible with IBM 3420, Pertec 1600/6250, STC 1600/6250, Telex 1600/6250.
Modgraph introduces
"Smart Graphics"

Smart because one low cost terminal provides easy to use graphics and a completely independent alphanumerics overlay.

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GENERAL FEATURES: 15” P-39 Green Phosphor Screen • High Resolution CRT • Special Function Keys • Detachable Keyboard • RS-232C Interface • Set-Up Mode from Keyboard • Many Options Available

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MINICOMPUTER TECHNOLOGY

Products: Model EDC21 disk controller which emulates DEC RH11 controller interfaced to multiple RM02/03/05 disk drives. Also: Turbo 21 single board add-on disk cache which eliminates up to 80% of all disk access time. Both products just introduced.

MOSTEK CORPORATION
Product: Memory.

NATIONAL INSTRUMENTS
Products: GPIB 11V-2 high speed DMA interface between DEC Q-bus micros and the IEEE Std. 48 bus. Increases data throughput up to 100 times.

MINICOMPUTER TECHNOLOGY

Software

Chairing the panel on software will be Douglas I. Michels, Vice President and co-founder of The Santa Cruz Operation, Inc., a management and consulting firm specializing in the application and support of UNIX systems. Michels, as well as other noted authorities, will focus on operating systems and applications programs. Panel members will explain their views on the current direction of software and the latest in languages, such as UNIX and ADA. Mr. Michels, in particular, is a leading expert in UNIX, an operating system at Bell Labs.

Panel members:
- Gary Kildall, Digital Research
- Paul O'Grady, Microfocus
- Mike Saccaman, Ryan McFarland
- Mark Ursino, Microsoft

Time: Wednesday, September 16, 10:00 A.M.

Memory Systems

Heading up the talks on memory systems will be Gerald H. Kiltz, Product Marketing Manager, Fixed Disk Drives, for BASF Systems Corp. Kiltz and his panel members will aim their talks at the OEM systems designer, furnishing useful data not only on floppy, hard disk (Winchester), and tape drives, but on semiconductor board level memory as well.

Panel members:
- Thomas Knight, National Semiconductor
- Gail R. James, Qume
- Kim Kelly, Pertec
- Robert Oakley, Data Electronics, Inc.

Time: Thursday, September 17, 9:00 A.M.

National Instruments

Controllers

The topic of controllers will be addressed by Jack Olson, Vice President of Marketing for Western Peripherals, a division of Wespercorp. Mr. Olson, who formerly held various positions at Datum, Inc., will cover what's happening to the technology because of changes in hardware and software. He'll also brief attendees on what to expect a few years down the line. Other panel members will zero in on specific types of controllers on which each is an expert.

Panel members:
- Drew Krycerick, Wespercorp
- Bill LeDuc, National Semiconductor
- Doug Kolb, Signetics
- Dave Vedner, Macrolink
- Nick Horn, Minicomputer Technology

Time: Wednesday, September 16, 9:00 A.M.

Input/Output Peripherals

Tackling the subject of I/O peripherals will be Ian Turner, Director of Printer Engineering at Data Products' Serial Printer Division. Mr. Turner has been associated with some of the leading hardware manufacturers, and has a broad background in designing computers and printers of all types. The panel will speak to the systems engineers, informing them of the latest industry developments and the changes they foresee in the future.

Panel members:
- Ken Freund, Dataproducts
- Hiram French, Megatek
- Mike Watt, Calcomp
- Wayne Smith, Lear Siegler

Time: Thursday, September 17, 9:00 A.M.
modules including video work station, line printer, interface guide, and box enclosure. Video unit to be displayed for first time.

**NEW WORLD COMPUTER COMPANY**
Products: Mikro-disc V — a 5 1/4" disk drive with removable cartridge. High performance, compatible with S-100. Available in five models and two interface configurations.

**PICEON, INC.**
Products: Model PM 2010 smart terminals. Also: S-100 based memory controller, Cromemco “Cromix” compatible boards.

**QANTEX (Div. of North Atlantic Industries)**
Products: Winchester disk back up high-capacity drives, high-speed dot matrix printers, OEM cartridge tape drives, and tape storage for small systems.

**QUALEX TECHNOLOGY, INC.**
Products: Model 1000 high performance, triple density tape system for HP 1000 users, SMASH (Shared Mass Archive Storage Host).

**QUENTIN RESEARCH, INC.**
Products: Models 4107, 4111, and 4118 ULM transparent multiplexers. Also: Models 4307, 4311, and 4318 ALM/ATM software transparent multiplexers, and the 4808 8-port DMA multiplexer. First public showing of these models.

**SPECTRA LOGIC CORP**
Products: Emulating disk and tape controllers for DEC, DG Nova and Eclipse, and Perkin-Elmer mini- and microcomputers. Featured: DG-compatible Spectra 10; single function DEC-compatible Spectra 11; and several other models.

**TECHTRAN**
Products: Porta 210 — includes the 800 series portable Philips-type cassette recorder data entry system, and the 900 series 5 1/4" disk line. 800 series available in two sizes with dual RS232 ports. 5 1/4" disk hosts same interface and features double bit density.

**TECSTOR, INC.**
Products: Sapphire 160 14" Winchester disk drive. Replaces CDC 9730, DEC RM80, and others.

**WESTERN PERIPHERALS, Div. of Wespercorp**
Products: Disk and tape controllers for DEC PDP-11, including model DC-231, a DEC-emulating RM02 disk subsystem.

---

The Problem: Glare from CRT displays. Eye strain. Inefficiency. Loss of operator-hours. The ergonomic difficulties of interfacing man and CRT are growing. OCLI has the solution: HEA® — High Efficiency Antireflection Coating. HEA reduces glare by 94% while optimizing contrast. It improves the operator’s visual efficiency and comfort. It’s cost efficient. It’s the solution. For more information write, phone, or TWX: OCLI, Dept. 109-DQ, 2789 Giffen Ave., P.O. Box 1599, Santa Rosa, CA. 95402. (707) 545-6440. TWX: (510) 744-2083.
The Computer Compatible Directory
Part One

a listing of plug-compatible peripherals and products

Two-Part Directory

Due to the overwhelming volume of responses, the Computer Compatible Directory has been extended into two issues. This issue covers the following product categories: AC/DC Power Supplies, UPS, Line Conditioners, Add-In/Add-On Memories, Array Processors, Communications, Controllers, Disk Emulators. The second half of this directory will run in September and will cover: Display Terminals, Flexible Disk Drives, Packaging/Hardware/Backplanes/Enclosures, Printers/Plotters, Rigid Disk Drives, Services, Software, Special I/O’s, Tape Systems, Test Equipment/Instrumentation, Other. The complete manufacturer's listing from all categories is listed in both issues.
This two-part directory is the industry's first computer compatible directory, meeting the needs of both OEM integrators and system designers. Locating compatible memory and peripherals for DEC, DG, P-E, HP and other computers for integration into systems intended for use in the scientific, engineering and industrial fields can be a problem; many system designers must scan through our magazine looking for relevant advertisements and new product announcements, either marking up and saving the issues, or clipping and filing the listings. The editors of Digital Design were sure that our readers had better ways to occupy their time.

You no longer need to read Digital Design with scissors in one hand; here is the industry at a glance. Due to the tremendous response, we extended the directory to two issues. This month's directory covers the following product categories: AC/DC Power Supplies, UPS, Line Conditioners, Add-In/Add-On Memories, Array Processors, Communications, Controllers, Disk Emulators. The second half of this directory will run in September and will cover: Display Terminals, Flexible Disk Drives, Packaging/Hardware/Backplanes/Enclosures, Printers/Plotters, Rigid Disk Drives, Services, Software, Special I/O's, Tape Systems, Test Equipment/Instrumentation, Other.

Although our staff used scientific and orderly data gathering techniques in collecting information to provide the most comprehensive and accurate listings, some bits of information may have escaped us. If so, please call any errors or omissions to our attention.

What surprised us most was the number of categories of computer compatible products; and, since many manufacturers checked "other" on the questionnaire, we listed most of them as such. When possible, we tried to create new categories; but for the most part, this was not possible: many categories had just a few products, making it difficult or impossible to create separate categories for them.

A word about acronyms and nomenclature: Product models/numbers are boldfaced with heavy type. Each new product starts a new line. To prevent redundancy, only company names are listed after their products; a separate listing includes company names, sales contacts, addresses and phone numbers.

Following the product name/number is a brief description. Vendor maintenance and number of field offices (FO) and/or third party service is listed. The acronym "RTFM" means return to factory for maintenance. "Compat" is "compatible". "HW/SW" is "hardware/software".

We will expand this directory in future issues. Our next computer compatible issue will contain descriptions of new products introduced between now and then, as well as any manufacturers who missed last April's questionnaire. If you were left out and want to be listed in our next directory, please fill out the questionnaire at the end of this directory. Use photocopied forms for each product. Please, don't take the easy way out and write, "See spec sheet"; we cannot reprint spec sheets. Include in your mail-back such material as press releases, photos, manuals, literature, articles, etc.

If your firm manufactures computer compatible products, and you don’t see them listed here or next month (or if you are introducing new products), this will prove an excellent opportunity to be listed free in a directory that will be read by 67,000 direct (198,000 total) readers — leading computer system integrators throughout the industry. We're sure system integrators and designers will save this directory and actively refer to it over the next 12 months.

Illustration by Josh Randall
AC/DC Power/UPS/Line Conditioners

Power Conditioners/Uninterruptible Power Systems

Operates as a Power Conditioner to eliminate transients, voltages and surges, lightning, single phasing, dirty off/outage, and as an Uninterruptible Power System to bridge light flickers and utility outages of up to 500 ms. $14,000 and up; Vend Maint, 5 FO.


AC Power Conversion Equip.

Inverter solid-state voltage or current sources, frequency and phase converters, and AC line regulators: RTFM. California Instruments, Div of Norlin Industries, San Diego, CA.

Uninterruptible Power Systems

Provide steady clean power to sensitive computer systems; protects the power against brown outs, black outs, power surges, etc., available from 750 VA to 30 KVA; Vend Maint.

Clary Corp-Precision Instruments Div., San Gabriel, CA.

OL25/50

50W on board, 5.92" x 3.82" x 1.65". Drops in the same socket as Boschert OL25 (25W). 75% efficiency. 110/220V strappable std., short circuit and overload protection.

Compower Corp, Campbell, CA.

Power Conditioning

Sells and services full line of power supplies and conditioners; isolation transformers, motor/generator sets, UPSs, and power-line conditioners: S500-$50,000; Vend Maint.

Computer Power Solutions, Placentia, CA.

Uninterruptible Power Systems

Models UPS-501-1 through UPS-453-3; single and three-phase systems available from 600VA to 45KVA; several models are seismically-qualified units; $3340 to $49,490; Vend Maint, 3 FO.

Elgar Corp, an Onan Power Systems Co., San Diego, CA.

UPS—2 Series

DSU & 5000A Series: DSU Series, 700 VA to 1800 VA; 5000A Series, 3 KVA to 37.5 KVA; Vend Maint, 2 FO.

Gould-Deltac, San Diego, CA.

Load Ramp Control

Provides gradual and stepless application of voltage when turning computer on, reducing inrush current. $1750 and up.

Overvoltage Panel

Designed to sense line voltage conditions, removing voltage from computer if voltage exceeds prescribed limits for a selected length of time: $1750 and up.

Donald C. Harder Co., San Diego, CA.

MPD 208

Power controller DEC VAX Compatible: 3 Phase 120/208 VAC at 90 amps; 6 switched outlets & 3 unswitched outlets: interchangeable with DEC VAX 869 series power controller; $1650.

MPD 416

Power controller is DEC VAX compatible: 3 Phase 240/416VAC at 45 amps; 6 switched outlets & 3 unswitched outlets: interchangeable with DEC VAX 869 series power controller; $1375.

MPD 7100

Switching power supply: DEC VAX Compatible: 120/240 VAC input 47-63 Hz; 5.1V output at 100 amps; mechanically and electrically interchangeable with DEC VAX 11/780 power supplies; $2,475.

MPD 115

Power controller: DEC compatible: controls 30 amps at 115VAC; has 8 switched and 4 unswitched outlets; this unit is compatible with DEC 861 series high performance EMI filter, remote control & optional delay; $325.

MPD 115A

Power controller, DEC compatible: controls 30 amps 230 VAC (4 wire) input, 115VAC output; 8 switched and 4 unswitched outlets; high performance EMI filter; remote control & optional delay; DEC 861 compatible; $375.

MPD 110

Power controller controls 15 amps at 115VAC: has 10 unswitched outlets on the standard unit; has 8 switched and 2 unswitched outlets with remote option; standard high performance EMI filter, special FCC filter available as option; $149.

MPD 220

Power controller controls 15 amps at 230VAC: has 10 unswitched outlets on standard unit; has 8 switched and 2 unswitched outlets with remote option; standard high performance EMI filter, special FCC filter available as option: $214.

MPD 230

Power controller is DEC compatible; controls 20 amps at 230VAC; has 8 switched and 4 unswitched outlets: this unit is compatible with DEC 861 series power controllers; high performance EMI filter, remote control and delay option; $425.

MPD 2010

Power controller controls 15 amps at 230VAC input (4 wire) 115VAC output; has 10 unswitched outlets standard; has 8 switched & 2 unswitched outlets with remote option: standard high performance filter, special FCC filter available; $176.

MPD 117

Power controller: line filter & power distribution for home and office equipment: handles 10 amps at 115VAC with 6 switched & 2 unswitched outlets: high performance EMI filter; $89.

Marway Products Inc., Santa Ana, CA.

1000 Watt Switching Power Supply

165-265 VAC input, or 115/230 VAC strappable; meets stringent FCC class B and VDE 0871 class B EMI requirements; 40mS hold-up time; 80% efficient; fully self protected; fail safe remote sensing; meets all of the latest requirements for EMI; $795 (qty 1).

Powertec, Chatsworth, CA.

OmniBus Power Distribution Center

Workstation model, free-standing rollabout models, and 19-inch rack-mount model: UL listed, 57-63 Hz: output power is 10 kVA, 15 kVA, 22.5kVA, 30kVA, 37.5 kVA; input voltage 208V, 240V or 480 V, three-phase: $4685 to $6950. Contact DPP Div. of Topaz, Pl. Power Conditioner

With Distribution P1 with 5.0 kVA to 10.0 kVA: 50 Hz and 60 Hz: nominal output voltage 117/220/234 VAC; efficiency is 94% minimum; regulation band: 7%; $2000-3250. Contact Electronics Div. of Topaz.

Series 82000 UPS

0.5kVA to 1.0kVA: 50 Hz and 60 Hz: Single-Phase: UL Listed, 115 VAC Output/Input: $4990-$9590. Contact Electronics Div. of Topaz.

Series L6 AC Voltage Regulators

Output voltage regulation bands: Type 1 ± 10% of nominal; Type 2, ± 5%, 10% of nominal; Type 3, ± 5% of nominal; 96% efficiency minimum; operating frequency of 47 to 63 Hz: 1 kVA & 2 kVA: $938-$1313; Contact Powermark Div. RTFM. Topaz Inc., San Diego, CA.

Add-In/Add-On Memories

SCAT/45 Add-In Parity Memory

PDP-11/45, -11/50, -11/55. Enables all 256 KB of memory to reside on Fastbus. Dualport, and can be used with either DEC bipolar or MOS already on Fastbus. Model 10019-0, 64 KB, $13,500; 10019-1, 128 KB, $23,500; 256 KB, $44,650.

CACHE/445


CACHE/435, CACHE/440


Able Computer, Irvine, CA.

Digital Design AUGUST 1981
1816 CMOS
16K word CMOS RAM with battery backup for LSI-11. -11/-2, -11/23. $1995. Vend Maint, 47 FO.
ADAC Corp, Woburn, MA.
Mostek MK8000 Series
32K to 2MB, add-in, add-on, cache, fast parity, and upgrade memory for Q-Bus, Unibus, and Massbus systems. Vend Maint, 4 FO.
Advanced Digital Products, San Diego, CA.

Floppy Mem
To replace NC machine tool's tape reader and tape with high speed, reliable floppy memory. Vend Maint.
Alden Computer Systems, North, MA.

M-8
Solid state non volatile memory in 1/4 MB increments. $20,000/MB, 45 FO.
Alpha Data Inc, Chatsworth, CA.

ARM-10XD
DEC comp. 256K, 512K, 768K, and 1024K word capacity, 4 to 8 ports, 2 or 4-way interleave, SW transparent.
Megastore 11
DEC comp. 259 ms block access and transfer time; 3 ms access; 128K to 2048K/sec transfer rate; 256K to 4096K capacity; 256K expansion increments; Unibus compatible; totally transparent.

Megastore 1223
DEC comp. 1.8 ms block access and transfer time: 200,000 wps transfer rate: 256K to 2048K word capacity; totally transparent; dual port option. Vend Maint.
Ambex Corp, Memory Products Div, Ewing, NJ.

MEM
LSI-11 Q-Bus. Dual width module provides from 16 K to 256 K of dynamic memory. Parity also available. $700-$3240.
Memorex Corp, Anaheim, CA.

AC5/Motorola 128K
Self-diagnostic 128K memory compatible w/Vang MWP, LVP, and VP. Detects parity errors in incoming & outgoing data indicated on card edge LEDs. Manufactured & Warranted for 1 year by Motorola. $533.
Automated Control Systems Inc, Bellevue, WA.

5000 Series
High performance, PDP-11 Comp. Offers a wide selection of memory capacities up to 256K x 18 in 32K increments. Unibus and modified Unibus capable. Requires only one Unibus load.

2626-D
PDP-11/70 compat. Flexible expansion capacity available in 64K increments to 256K max. Includes on-line/offline switch for troubleshooting or configuration procedures.

7512-D
Comp. with VAX-11/780 HW, SW, standard peripherals & system options. 64K x 72 (512K) NMOS random access card. Easy to install. Vend Maint, 55 FO.
Braegar Minicomputer, Peripherals Div., Anaheim, CA.

2116 16K Static Memory Board
2116 type static memory. Available in 450 or 2004 address, access at 4K boundaries, configurable to 4, 8 or 12K w/o removal of RAM, phantom enabled, bank port/bank byte select to any one of 8 banks. $349.95

2032 32K Static Memory Board
2116 type dynamic memory, 200 ns access, 16K bank independent, configurable to 16, 32 or 48K w/o removing RAM, phantom enabled jumper. S100 Bus compatible. $270, RTFM, 15 FO.
California Computer Systems Inc, Sunnyvale, CA.

National Semiconductor
11/34, 11/70, 11/750, 11/780
Retail, system integrator. Vend Maint, 1 FO.
California Datasearch Systems & Financial Corp, Anaheim, CA.

MicroSTOR-11
Compatible with CII-1 203/23, Q-Bus. Storage capacity — 16K, 32K, 48K or 64K words. On board parity, refresh options. Dual height board.

SuperSTOR-11
VA-780
Compatible with VAX-11/780. Full ECC compatibility. Direct replacement for DEC's M8210 main memory board. Storage capacity — 256K. Expands main memory to 4 MB.
Cambridge Corp, Waltham, MA.

CIS 10
64K x 8 memory for S100 based systems. Access time 225 ns. Bank select option for addressing to 512K. $575.

Cl-1123
256K x 9 memory for LSI 11/23. Has parity, access time 240 ns, addressable to 4MB. 256K $1925, Qty 100 $1475, 128K $1550.

Cl-8086
128K x 9 to 512 x 9 memory for Multibus compatible systems, has parity. Access time 270 ns. Addressable to 16MB. 128K $1350, 512K $2995.

Cl-8080
2 for Motorola Exercisor systems. 64K x 9. Has parity, access time 225 ns. Addressable on VXA or VUA. $575.
Chrislin Ind Inc., Westlake, CA.

MR80
NMOS version: 16K or 32K; CMOS version: 8K, 16K or 32K. Multibus memory static RAM, power fail interrupt logic, battery backup for CMOS versions. 8 or 16 bit operation. From $450. 3 FO.
Comark Corp, Waltham, MA.

NS-23L
Q-Bus (LSI-11) memory modules 64KB, dual height module. $500-64K, $1200-128K, $2200-256K.
NS-11L
Unibus memory module, 256KB, single module. $2250. RTFM. Compumart Corp, Cambridge, MA.

94144 Semiconductor Memory
PDP-11/44. Includes ECC. 64K x 39, 128K x 39, 256K x 39. 525 ns read cycle time, 900 ns write cycle time; battery back-up. OEM qty, 128K x 39 (512KB) - $5050.

94123 Semiconductor Memory
LSI-11/2 to LSI-11/23. Up to 64K x 16/18 capacity. Full cycle time — 500 ns, full access time — 240 ns. OEM qty, 32K x 18 — $590.

94134 Semiconductor Memory
DEC 11/04 to 11/34. Up to 128K x 18 capacity. Full cycle time — 500 ns; full access time — 350 ns, 32K x 18 up to 128K x 18. OEM qty, 64K x 18 — $1130.

94134P Semiconductor Memory
DEC 11/04 to 11/55. Includes Parity. Up to 256K x 18 capacity by using double density (32K) chips. Full cycle time — 500 ns; access time — 350 ns; 16K x 18 up to 256 x 18 capacity. OEM qty, 64K x 18 — $1210.
The Computer Compatible Directory
Part One

Add-In/Add-On Memories

94170 Semiconductor Memory
DEC 11/70. Up to 4MB capacity. Full cycle time — 600 ns; access cycle time — 460 ns. 256kB to 4MB capacity. OEM qty. $1525. Vend Maint. 12 FO. Digital Data Corp., Computer Memory Div., Bloomington, MN.

94178 Semiconductor Memory
DEC VAX. Full cycle time — 400 ns; full access time — 250 ns. OEM qty. $1525 — $1535. Vend Maint. 12 FO. Control Logic Inc., Reading, MA.

CCS-1220 EPROM Programmer

720/Memory Expansion Unit
Memory expansion, memory parity, memory protect, multiple/devide options available. $3600 full configuration. Vend Maint. Custom Systems Inc., Eden Prairie, MN.

RM-117 Dual Port RAM
Intel Multibus. Complete memory management with 16kB on board RAM. Support dual processor with common RAM resources. $1200 (1-9).

CM-126 Universal RAM/ROM
Intel Multibus. Complete memory resource on one board. Accept 32 different RAM/ROM/PRROM/EPROM, user selectable access time. Up to 128kB per card. $695 (1-9).

EM-115 Dual Port RAM Expansion
Intel Multibus. Efficient add on to RM-117. Contain additional 16kB RAM and 8kB PROM/ROM. $650 (1-5).

PM-116 PROM Memory
Intel Multibus. Total PROM-ROM memory module for Multibus, can hold over 1 meabit of standard PROM-ROM memory. $265 (1-9).

RM-119 64kB Dynamic RAM
Intel Multibus. High density RAM storage. Low power consumption, support 20 bit addressing. $960 (1-9). Datacube Inc., Reading, MA.

DR-15116K x 8
16Kb core memory for Intel's 8010/8020 computers. $930. BC-801 Memory System
256Kb to 2MB of core memory for the Multibus. $10,100.

BS-801 Memory System
512Kb to 8MB MOS/ECC Multibus memory. $9530.

DR-70 16K x 16
Core memory for use with Sperry-Univac V71, 72, 73, 74, 75 and 76 computers. $3345.

V70S 256K x 32
512Kb MOS/ECC memory board for Sperry-Univac V77-600. $9860.

DR-477 Memory System
32Kb to 512Kb core memory expansion for Sperry-Univac's V77-400 computer. $5355.

DR-1200 16K x 16
Core memory for use in DG's 1200, 1210, 1220 and 1230 computers. $1760.

DR-124 16K x 16
Core memory for use in DG's NOVA 2 series computers. $1760.

DR-123 16K x 16
Core memory for use in DG's NOVA 3 series computers. $1760.

DR-1235 128K x 17
MOS memory for use in DG's NOVA 3 series. $2970.

DR-1259 128K x 21
MOS/ECC memory for use in DG's ECLIPSE. $3520.

DR-118 16K x 12
Single quad core add-in memory for DEC's PDP-8/E, E, F, or M computers. $2120.

DR-118A 32K x 12
Single add-in memory board for DEC's PDP-8/A. A 16K x 12 version is also available. $2800.

DR-118B 128K x 12
Single board MOS memory for DEC's PDP-8/A computer. $6110.

DR-716 16K x 17
32Kb core memory for P-E's 50, 55, 70, 74, 716, 7/526 and 8/32 computers. $2000.

DR-717 32K x 17
64Kb core memory for P-E's 50, 55, 70, 74, 716, 7/32, 8/32, 8/16 computers. $3570.

DR-320S 512Kb Memory Module
Single board MOS memory for P-E's 3220 and 3240. $6630.

BS-417 Memory System
512Kb to 4MB MOS/ECC memory expansion for DEC's PDP-11/70. Includes chassis, power supply and cables. $5000.

DR-178S 64K x 72
A 512Kb version of DEC's M82100 semiconductor array for the VAX-11/780. $3060.

DR-175S 64K x 39
A 256Kb equivalent to DEC's M8728 semiconductor array for the VAX-11/750. $2400.

DR-1205 64K x 43

DR-114 32K x 18
Single board mode memory for use with DEC's PDP-11 Unibus computers. $2745.

DR-114S 128K x 18
256Kb single board MOS memory operates with DEC's M7850, for use in the PDP-11 Unibus computers. $2125.

DR-114SP 128K x 18
256Kb single board MOS memory with on-board parity control for use with DEC's PDP-11 Unibus computers. $2205.

DR-144S 1024Kb Memory Module
1MB MOS/ECC memory plugs directly into the PDP-11/44 backplane. Operates all current DEC diagnostics and operating systems for the PDP-11/44. $9000.

DR-115 16K x 16
Core memory for use with DEC's LSI-11 series computers. $1540.

DR-115S 32K x 16
MOS memory for use with DEC's LSI-11 series computers. Parity version also available. $610.

DR-113S 128K x 16

PDP-11 Unibus Memory
DMS 11 LB, D is HW, SW compat with PDP-11 series. 128Kb x 18 bit to 256Kb x 18 bit. 500 ns full-cycle time; 375 ns access time.

PDP-11 Memory
DMK 11 is HW, SW compat with PDP-11/70. 600 ns read cycle time; 800 ns write cycle time; 460 ns access time. Stores up to 4MB.

VAX Memory
DMS 780. 32K x 72 bit, 256Kb card. 400 ns cycle time; 250 ns access time; 800 ns write cycle time; 400 ns refresh cycle time. Vend Maint, 4 FO. Data Systems Services, El Toro, CA.

Core and Semiconductor Memories
Complete line of boards compatible with DEC, NOVA, HARRIS, 100% compat, 1 yr guarantee. Custom designs available. Vend Maint, 3 FO. Digital Data Systems Inc., Plantation, FL.


BSC-256
Bank-switch-controller. Controls up to 2MB of RAM or ROM using the RMA-032 and RMS-016 memory boards. Vastly expands LSI-11/2 memory space. Dual width board appears as registers in peripheral space. Contains 32 word prom bootstrap. $300.

RMP-116
EPROM Programmer/Memory Board. DEC PDP-11 Unibus. Holds 16K words of Intel 2716 or TI 2516 EPROMs. Programs and executes from any socket. $650. Digital Pathways Inc., Mountain View, CA.

ECC128 Intel Multibus
Dynamic RAM with error correction. $2200/up.

SM/32
Intel Multibus compatible static RAM. $450. Distributed Computer Systems, Waltham, MA.

MSV11
General purpose LSI-11 64Kb memory board. $1,000. $650-100 qty.

General Robotics Corp., Hartford, WI.

MAXIRAM-570
Main memory for PDP-11/70. Up to 4MB, interleaved operation.
Switch selectable memory area allocation. Capacity from 512 to 4K 16-bit words. On board regulated –5VDC supply. $195.

**MLSI-MRV-001 LSI-11 PROM Module**
- 8 sockets accommodating 1702 PROMS or equivalent. Switch selectable memory area allocation. Capacity from 256 to 1K 16-bit words. On board regulated –9VDC supply. $195.

**MLSI-MRV-002 LSI-11 PROM Module**
- 32 sockets accommodating commercially available 5623, 5624 or equivalent PROMS. Switch selectable memory area allocation. Capacity from 256 to 4K 16-bit words. $195.

**Mega-4**
- 128K dynamic RAM board. Multibus. $650.$1470.

**IN-1671/SY-1671**
- 256, 512, 768, 1MB, 1.2MB, 1.5MB, 1.7MB, 2MB. PDP-11/70 add-on memory system in capacities from 1/4 to 2MB. System contains ECC memory, HW error logging and display, power supply and cooling. UL recognized, 1 year warranty. Manual supplied. $1100.

**CM-5151-266, CM-5151-512, CM-5151-1MB**
- Eclipse add-on memory board with ECC and HW error logging on board. Fully DG compatible including BMC and DUC options. Available in 1/4, 1/2 and full MB sizes. Features include 200 ns cycle time and both on-board and between board interleafing. 1 year warranty, manual. $5400, 1/4MB: $9000, 1/2MB: $15,000, full MB: $25,000, 2MB.

**CM-5160**
- NOVA 3 add-in memory card avail. in 4 configurations and 2 capacities (128kB and 256kB). Configurations with on-board memory management and protect unit (MMU) are unique in industry. Fully DG compatible, one year warranty, manual supplied. From $2400 for 128kB with parity to $4794 for 256kB with ECC, log, and MMPU. Vend Maint, 40 FO.

**Mega-1**
- 128K dynamic RAM board. Multibus. $650.$1470.

**Microsignal, Sunnyvale, CA.**

**Mega-3**
- 512kB dynamic RAM, 8202 MMU. Multibus. $680.$5775.

**Mega-2**
- Matrix Express Systems Ltd., TMF Quebec, Canada.

**MM-8080/16**
- 16kB of non-volatile core memory for Intel Multibus. $849.

**MM-8080B**
- 8kB of non-volatile core memory and 16kB of ROM/PROM compatible with Intel Multibus. $790.

**MM-6800D**
- 64 bytes plus parity RAM memory for Motorola microcomputer and Rockwell System 65. $600.

**MM-6800/16**
- 16kB of non-volatile core memory for Motorola microcomputer. $649.

**MM-6800**
- 8kB of non-volatile core memory for Motorola microcomputer. $725.

**MM-6800 S1**
- 32kB plus parity static RAM memory for Motorola microcomputer and Rockwell System 65. $650.

**MM-S-100**

**Intelligent Memory — IM-1680**
- Multibus compatible, 16K static RAM/16K EPROM and on-board Z-80 processor that allows operating on on-board data. $344 any qty. Vend Maint. Microsignal, Santa Barbara, CA.

**MSC 3602**
- PDP-11/70 memory system. Expandable in 256kB increments, provides up to 2MB of ECC memory in 1024 cells of rackmount space.

**MSC 3605**
- PDP-11/04 through 60 parity memory module. Provides a standard on-board parity control status register (CSR), parity generation and checking for the whole backplane. Selectable between standard and modified Unibus configurations, expandable in 32kB increments to 128kB.

**MSC 3606**
- PDP-11/04, 34, 60 parity memory module. Expandable in 64K increments to a full 256kB on a single board. On board parity generation, checking and CSR for the whole backplane.

**MSC 3607**
- Single port extended memory unit (EMU). Simulates the RF-11/RS-11 disk system. 128kB to 2MB in capacity. ECC to correct single bit errors and detect double bit errors. Error logging and battery backup optional.
Digital 256kB plug-compatible expansion memory. Direct replacement for the M 8728 memory, occupies a single Q-bus slot. 256kB and plugs directly into the VAX 11/750 memory system.

MSC 4605
LSI-11, 256kB dual card with 32K x 18 capacity, dynamic NMOS memory, battery backup, on-board refresh available. Parity bits present but generation does not occur on-board. Access time 330ns, cycle time 650ns.

MSC 4804
LSI-I1/23 compatible 256kB 22 bit address capability for applications up to 4 MB. Byte parity generation, checking and storage are standard.

MSC 4602/4802 Memory Expansion
16K to 64K RAM for 4602; 64K to 256K RAM for 4802. 4 sockets for 24 or 28 pin EPROMS. Full 20 line address decode, byte or word transfer mode, switch selected address map.

MSC 4605/4805 Memory Expansion with ECC
128K to 128K RAM for 4605; 128K to 512K RAM for 4805. ECC with double bit error detection, single bit error correction. FIFO buffer for up to 16 error messages.

MSC 8901 Memory Management
Allows 1 to 8 microcomputers to address 1MB of memory. Parallel bus arbitration logic for multi-processor applications. 20 bit address generation for processors with only 16 bit address capability.

Monolithic Systems, Englewood, CO.
**Array Processors**

PM-511E/64
128kB MOS board ECC.

PM-511L & PM-511L/F
Memory board replaces MS11L & provides 256 kB of MOS memory and on-board parity controller. SW transparent to DEC’s OS & diagnostics. 256 kB MOS memory for PDP-11. Single hex-board compatible with DEC’s OS/2 diagnostics. HW, voltage, signal, pin-to-pin compatible with Unibus backplanes. Refresh cycling. Supported by battery backup. Variable switch settings permit starting/stopping on any 8 kB boundary within extended addressing range of 0 to 4 MB.

PM-SJ11
High speed memory system for the PDP-11/70 has 256 kB storage to 1.5 MB.

Plessey Peripheral Systems, 17466 Daimler, Irvine, CA.

PM-KK 11A
High speed, 2 kB cache memory for PDP-11/34A central processor. Cache memory has required data for 85% of data requests that occur during typ. program operation.

PM-BA16
16,384-word by 12-bit random access core memory module for PDP-8A. Plug-in replacement for MM8-AB core memory. Operates with (or in place of) MM8-AA (8K) — or MM8-AB (16K) core memories.

PM-1132
64-kb core memory module operates on Unibus of PDP-11.

PM1132A
64 kB core memory module operates on Unibus of PDP-11.

Plessey Peripheral Systems, 1691 Browning, Irvine, CA.

3010 MEMORY
32 K word MOS memory for DG Nova 1200 and 800 computers. $2100. Vend Maint, 15FO.

Queintin Research Inc.

Northridge, CA.

MEM 16K-BES Static RAM Multibus (IEEE P-796), 8 and 16 bit mode, 16K (Byte Exchange). $745.

MEM 64K-BE Dynamic RAM Multibus, Byte Exchange, traditional three power supply. $995.

MEM 64K-D dynamic RAM Multibus, 8 or 16 Bit mode jumper selectable. $995.

Relational Memory Systems
San Jose, CA.

Dual-Ported Memory/ SKYMEM-Q
A dual ported Q-bus memory with 2 channels of A/D data operating at 1 MHz. 128kB. Ability to control 2 Reticon line scan or Matrix cameras for image processing. $5000. Vend Maint.

Sky Computers Inc.

Lowell, MA.

Dual-Port LSI-11 Memory/ LS-060
4K, 16-bit static RAM for interface with Q-bus or Unibus. Handles single-cycle DMA. Supports 18-bit addressing. Software transparent from both ports. $1495.

Semiconductor Memory/ LS-040
16K or 32K, or dynamic RAM with 256-word on-board PROM for systems bootstrapping and diagnostics. 450-ns cycle time. $495 for 16K. Vend Maint. 2FO.

Standard Engineering Corp.

Fremont, CA.

LEC-16 and MAC-16
4K increments. Vend Maint, 17FO.

Telefield Computer Products Inc.

Irvine, CA.

PINCOMM 44S
MOS add-in memory for use in DEC PDP 11/44 and other extended Unibus applications.

$2500.

PINCOMM 70S
MOS add-in memory for use in DEC PDP 11/70 with MK-11 memory system.

$2300.

PINCOMM 24S
MOS add-in memory for use in DEC PDP 11/24 and other extended Unibus applications.

$2600.

PINCOMM PS
MOS add-in memory for use in PDP-11 Unibus family.

$1690.

PINCOMM HPS
MOS add-in memory for use in HP 1000 (high and std performance versions).

$1200 (426K).

$1680 (128K).

$3360 (256K).

$6720 (512K).

PINCOMM PE16S
MOS add-in memory for use in P-E series 16 (ECC and parity versions).

$590.

PINCOMM H6
MOS add-in memory for use in Honeywell series 60, level 6.

$1350.

PINCOMM N
Core add-in memory for use in DG Nova 2, Nova 3, Nova 1200.

$1758.

PINCOMM I
Core add-in memory for use in P-E (Interdata) 7/32, 8/32.

$2034.

PINCOMM AS

$1835 (128KB).

PINCOMM A
Core add-in for use in General Automation SPC-16, 18/30, 390/440.

$1983.

PINCOMM CS

$1200 (426K) w/ battery backup. Qty discounts available on all. Vend Maint, 2FO.

Trendata Corp/Standard Memories.

Santa Ana, CA.

Head-per-Track Drum
4016/4401
High-reliability, high-performance add-on memory for PDP-11. 1 to 4 MB, 8.5 ms avg access, 16-word buffer controller interfaces PDP-11 via Unibus (OEM).


Head-per-Track Drum
4016/4402
High-reliability, high-performance add-on memory for PDP-8. MTBF exceeds 25,000 hrs. Storage capacity 2.35 megawards unformatted. 2.20 formatted. Avg. access 8.5 ms. Avg. transfer rate 235K words/sec.

Vermont Research Corp.

N. Springfield, VT.

ZX-028B 128KB RAM Card
Intel MULTIBUS compatible. Interfaces directly to any SBC-80 or SBC-86 Computer. Unpopulated or populated with 128KB. R/W buffers on each board buffer all data written into or read from the memory array. $1280.

Zenex Corp.

Dublin, CA.

**MARS-232**
Modular system which allows designers to configure multiple processor systems. Performance: 1K complex FFT 1.05 ms for a single processor.

$20K to 40K

OEM: $40K for full development systems. Vend Maint.

CNR Inc. Computer Products Div.

Northham, MA.

MSP-2X
DG single board 24-bit block floating point data format. Library of Fortran callable signal processing routines. 1K point real FFT in 14.3 ms. $3950.

MSP-3000 Floating Point
Programmable thru Fortran calls of library subroutines or in mini- or macro-language. DEC 32-bit single precision data format. 1K real FFT in 7ms.

$19,500/in expansion chassis: w/ 1/4 MB — $29,200.

Computer Design and Application Inc.

Newton, MA.

MAP 200
32-bit floating point, 7.5MFLOPS, full operational and development software provided. Complete systems from $30,500.

MAP 6400
32-bit floating point, 3MFLOPS, full operational and development software provided. From $89,000.

MAP 300
32-bit floating point, 15MFLOPS, full operational and development software provided. From $40,000. Vend Maint, 60 FO.

CSP1.

Billerica, MA.

IP8500
DEC Unibus compatible, with digital video processor, video output controller. Image array processing using up to 20 512 x 512 x 8 bit image memories. Color or monochrome. A true state-of-the-art product. Up to 4 simultaneous users. From $40,000 to $200,000. Vend Maint, 2 FO.

De Anza Systems Inc.

San Jose, CA.

AP-180V
Fully-programmable, 38-bit, attaches to VAX DR780 high-speed interface. 12-milion floating point operations/sec. $90,000-$160,000.

AP-190L
38-bit, interfaces to IBM 370 series, DEC 10 computers, and UNIVAC 1106, -08, -10. Programmable with Fortran Compiler, chainer, or assembly language. Library with 250 routines. Channel interface. 12-milion floating point operations/sec. $150,000-$250,000.
Array Processors

**AP-120B**
38-bit, programmable with Fortran compiler, chainer, or assembly language. Application library of 250 routines. 12-million floating-point operations/sec. Interfaces to PDP 11 series, VAX 11 series, HP 21 MX, PE 3200 series, Sol 32 series, Harris series. $48,000-$155,000.

**FPS-100 Arithmetic**
Compact, fully programmable 38-bit array processor offered on an O.E.M basis. Special provisions for multitasking and real-time operations. Interfaces to PDP 11 series and DG Nova series. Providing 8-million floating-point operations/sec. $24,000-$85,000.

**FPS-164 Attached**
Large memory, fully programmable 64-bit array processor that interfaces to: VAX-11 series Unibus and IBM 370/303X/33XX series selector or block multiplexor channel. Main memory to 1.5 million words. 12-million floating point operations/sec. $159,500-$589,800. Vend Maint, 13 FO.

Floating Point Systems, Portland, OR.

**Micro Number Knurcher SKYMNK-Q**
LSI 11, LSI 11/23 Q-Bus compatible. Does floating point in 32-bit single precision, 48-bit extended precision. Provides full digital signal processing at Megaflop speeds. On 2 quad modules. $5990 single unit; under $4000 qty over 100 units.

**Micro Number Knurcher SKYMNK-M**
Multipurpose compatible array processor for 16-bit micros — Intel 8080, Z8000. Does floating point (IEEE STD) in 32-bit single precision and 48-bit extended precision 20-bit bus address. 1 Megaflop processing on 2 SBC modules. $5990 single unit, under $4000 qty over 100 units.

**Micro Number Knurcher SKYMNK-V**
Versabus/M-68000-based array processor. Does 32-bit single precision, 48-bit extended precision in IEEE floating point format. 1 Megaflop speed on Versabus module format. $5990 single unit, under $4000 qty over 100 units.

**Micro Number Knurcher SKYMNK-02**
Floating point array processor. 32-bit single precision, 48-bit extended precision. Does digital buffering, FFT, Vector operations... programmable from host processor currently supported under RT-11 and RSX-11. Whole processor system or two modules. Driver software, Vector SBC software and software simulator for SKYMNK-02 free with system. $5990 single unit, $4000 in qty 100. Vend Maint.

Sky Computer Inc., N. Chelmsford, MA.

**DHa/DM 10100-1**
DEC DH11 and DM11-B Replacement. A microprogram controller with modern control, connecting the Unibus to 16 sync comm lines. $4100. Vend Maint, 1 FO. Able Computer, Irvine, CA.

**Able Interprocessor Links**
DMA Interface, Bus Converter, Memory Modules, 5 V regulators, Backplanes, Terminators and Bus Repeaters. Manufacture, wholesale. Vend Maint, 4 FO. Advanced Digital Products, San Diego, CA.

**Cables**
EIA RS-232C, extended data cable, twin or coaxial cable. Also port to port switch boxes, connectors and piece parts. RS-449 cable also available. Distributor, 1 FO.

American National Supply, Anasco, Gardena, CA.

**IF-11/3270**
Communication package allows IBM 370 user to remotely attach 8 terminals and a PDP-11 to an IBM controller. Emulates IBM 3271 remote cluster control unit with IBM 3277 display terminals attached. X/3270 units may be increased to 31 terminals. $11,400.

**IF-11/3780**
Package which emulates IBM 3780 (or 2780 or 2770) control unit for IBM 370. Allows PDP-11 to connect, by either of 2 channels, to the IBM 3705 or any 3780 protocol host. $8,000.

**IF-11/HASP**
Allows RSX-11M-based PDP-11 system to emulate a HASP Remote Work Station. Provides Multi-leaving service for Remote Job Entry and File Transfer to Host Processor. $8,000.

**IF-11/U200**
μP-based package allows Univac 1100 users to attach multiple terminals and a PDP-11. Emulates a multiplexer cluster control unit with multiple U200 display terminals attached. Supports 8 terminals; add-on X/U200 units increase capacity to 31 terminals. $11,400.

**IF-11/DCT1000**
μP-based package allows Univac 1100 users to attach multiple terminals and a PDP-11. Emulates a multiplexer cluster control unit with multiple DCT1000 display terminals attached. Supports 8 terminals; add-on X/DCT1000 units increase capacity to 32 terminals. $11,400.

**IF-11/UNTR**
μP-based unit which emulates a Univac 9000 Remote Batch Emulator. Connects to PDP-11. Up to 2 remote Univac mainframes may be linked to the unit. Requires 1 hex SPC slot. $8,000.

**IF-11/X.25**
μP-based network package supports X.25 protocol levels 1, 2, and 3. Establishes calls to remote sites via Telenet, Tymnet or appropriate private X.25 network. Allows up to 32 simultaneous virtual calls. $10,000.

**IF-11/1822**
Programmable attachment for PDP-11. Allows operation with an ARPANET IMP (1822 protocol). The number of 1822 connections can be increased by adding optional X/1822 boards. $7,900.

**IF-11/0/1822**
Full-duplex DMA controller used to attach an LSI-11 to an ARPANET IMP. If more than one IMP connection is required, optional XQ/1822 boards can be added. $3,500.

**LH-DH/11**
Full-duplex DMA controller used to attach a PDP-11 to an ARPANET IMP. Operates in Local or Distant Host mode. $6,500.

**IF-11/ECU**
μP-based attachment for PDP-11. Contains 1822 interface controller and ECU-11 Logic Module. Format is a version of SDLC. Transmission rates can exceed 1 MB/s. Requires a companion ECU/11 at the remote terminal. $12,500.

**VDH/11**
Full-duplex DMA error-checking communications unit connects a PDP-11 to an ARPANET IMP. Sends and receives bysync mode. Provides dual-buffered DMA on input and real time clock. For use on ARPA-style networks using 24-bit or 16-bit CRC. $6,500. Vend Maint, 2 FO.

Associated Computer Consultants, Santa Barbara, CA.
1022 Intelligent Modem

1030/1031 Intelligent Modems

B-DH11 Communications Multiplexer
Provide a buffered DMA-capable interface between a PDP-11 and multiple local or remote terminals. The B-DH11 is fully SW/HW compatible with the DEC DH-11. It occupies a single slot in the Unibus, requires only 1 bus load and interfaces upto 64 devices.

B-DZ11 Asynchronous Multiplexer
PDP-11 and VAX-11/780 compatible and SW compatible with DEC's DZ11. Provides a buffered program-controlled interface between a PDP-11 and multiple local or remote asyn terminals. Vend Maint, 55 FO. Bruegen Minicomputer Peripherals Div, Anaheim, CA.

11-0080 Multibus Megalink
Multibus compatible interface w/ intelligent networking controller. Enables party line transmission between ISBC/Systems to 9600/µP. Converts ISA-1 DMA mode at 1 megabaud rate over coaxial cable up to 32,000' long. Compatible w/other Megalink models for networking up to 255 processors. $2000, qty discounts.

11-0011 Q-Bus Megalink
Plugs into LSI-11 family & provides DMA transfers at 1 megabaud rate to up to 255 LSI-11's on one coaxial cable network, up to 32,000' long. Compatible on same network w/PDP-11 processors using 11-0016 Megalink. $7235.

11-0016 Unibus Megalink
Interfaces to PDP-11 family & provides DMA transfers at 1 megabaud rate to up to 255 PDP-11's or LSI-11's on one coaxial cable network, up to 32,000' long. Compatible on same network w/LSI-11 µP's using 11-0011 Megalinks. $5375.

80-0025 RT-11 Device Handler

DCA System 355 Network Processor
Master network processor for medium to large private networks. Used as stand alone network, multipoint multiplexing network, multilink network. Newest release x .25 gateway interface.

DCA System 205 Unibus Interface Statistical Multiplexer
Dec-Usb-based computers. Designed to provide cost-effective growth in applications using terminals at a remote site. Compatible with DEC PDP-11, VAX-11/780 and DEC System-20 computers. Used in point-to-point or multipoint configurations.

DCA System 115 Statistical Multiplexer/Network Processor
Network processor provides same features as 105 but supports up to 32 ports. Ideal for time-sharing vendors whose host computer site located long distance from group of customers. Eliminates need for expensive wats lines or long-distance service.

DCA System 105 Statistical Multiplexer
µP based stat. mux. used in point-to-point configuration or as a slave unit in full function network. Serves both terminals & host computers at either end of network. Used in single phone line networks connecting 2-8 terminals to a host computer site. Vend Maint, 36 FO. Sales reps located US, Canada, Europe. Digital Communications Associates (DCA). Norcross, GA.

DMS/M1200 Multibus compatible modem for direct connection to telephone (FCC certified). $950. Distributed Computer Systems. Waltham, MA.

DS11/H Communications Multiplexer
One hex-size board, occupying a single Unibus slot, handles up to 64 async lines on PDP-11 or VAX-11 system. Qty 1-4: $4950 for 16 lines. 1 yr warranty. 3 FO. Emulex Corp, Santa Ana, CA.

4261 RS232 Daughter Board
4 line RS232C compatible interface module for use with DG ALM16 or AT116. $115. Vend Maint, 1 FO. Interface Electronics, Southfield, MI.

8-Line Com-mux
RS-232 for P-E computers. $1900.

PADLA
2 RS-232 channels for P-E computers. $600.

QALT A
4 channel local terminal adapter for P-E computers. $675.

Macrolink
Anaheim, CA.
Z9600
0 - 9600 bps async short haul modem. Self test feature, data indicators, and 2 year warranty. Carrier detect, lightning protection and rack mount options available. $167 single unit, $117 in qty.

Madzar Corp.
Fremont, CA.

MIOB-A Teletype/RS232 Serial Async Interface
SW compatible to DG 4010 or 4077 interface. Switch selectable device address, 20 mA current loop/RS232, baud rate and character format. 16 selectable baud rates from 50Hz to 19.2KH. $358.

MIOB-B Optional

MIOB-C Optional Real Time Clock
Generates interrupts at programmed controlled rates of 60Hz, 10Hz, 100Hz or 1KHz. Compatible with DG operating system and diagnostic SW. Installed on MIOB-A. $275.

MIOB-A(B)-03 Optional Modem Control
First or second serial interface. Compatible with DG 4029 option to 4010 board. Add 03 after -A or -B both to designate which interface requires modem control option. $83.

8063-04
4 channel async communication multiplexor. SW compatible with 4063 multiplexer. Provides interface to 4 async data sets or local terminals with RS232-C interface. Switch selectable device address, baud rate and character format (controls all channels). $1045.

8063-08
8 channel async communication multiplexor. Identical to 8063-04 with 4 additional channels. Optional comm. panel with eight 25 pin connectors also available. $1595.

MDL-11 Async Serial Interface Module
PDP-11 compatible. Combined EIA RS-232-C, 20mA current loop and RS-422 interface circuitry on a single board. Switch selectable operating modes of DEC DLI-A, B, C, D or E modules. 16 switch selectable rates from 50 to 19.2K baud. Dip switch selectable device addressing and interrupt vectors, as well as all UART parameters. Capability for different transmit and receive data rates. $825.

MDL11-W Async Serial Interface
PDP-11 line frequency clock and combined EIA RS-232-C, 20mA current loop and RS-422 interface circuitry on a single board. Combines all functions of the DEC DLI-I-W, DLI-I-A and DLI-I-B modules on one board. Switch selectable baud rates from 50 to 19.2K as well as all UART parameters. $795.

DUP11 High Speed Synchronous Serial Interface
Single quad board. Complete modem control for full or half duplex operation. Includes all features of DEC Unibus DLI-I-DA, including on board hardware CRC or LRC checking and generation for Bit Oriented Protocols SCDL, ADCCP and HDLC. $1530.

DZ11-A Async 8-line EIA Multiplexer
Provides all features of DEC Unibus DZ11-I-A plus each line has programmable character formats and data rates from 50 to 19.2K baud. Contains a 64 character buffer with 16 character SILO counter. Upgradable to 16 line multiplexer with DZ11-B. $1950.

DZ11-C
Async 8-line multiplexor with combined EIA/20mA capability on a per line basis (provides operational features of DEC Unibus DZ11-I-A and DZ11-I-C within a single board). Each line is programmable from 50 to 19.2K baud. $2100.

DZ11-B
Async 8-Line EIA multiplexor module. Provides all features of DEC Unibus DZ11-I-B plus each line has programmable character formats and data rates from 50 to 19.2K baud. $1500.

DZ11-E
Async 16-line multiplexor provides all features of DEC Unibus DZ11-I-E plus individually programmable character formats and data rates for each EIA line from 50 to 19.2K baud. $3110.
Communications

H317-E EIA 16 Channel Distribution Panel
RETMA rack mountable. Used with one or two MDB or DEC DZ11-B multiplexer boards to provide DZ11-A or DZ11-E capabilities. $750.

H317-AC
EIA/20 mA Current loop 8 channel distribution panel. RETMA rack mountable. Used with MDB or DEC DZ11-B multiplexer boards to allow choice of 8 channels of EIA-RS-232-C or 20 mA current loop circuitry on a per line basis. When used with DZ11-B, provide combination of DEC DZ11-A and DZ11-C without the requirement for separate RS-232 or Current Loop modules and communications panels. $875.

MLSI-DUV11
Single line sync serial interface. Complete modem control. Sync or isochronous comm. modes, either half or full duplex. Transmitter and receiver double buffered logic permits a full character time for handling of interrupts. Provides level conversion between on-board TTL levels and EIA RS-232 or appropriate data set levels and accommodates transmission rates up to 40K baud. $700.

MLSI-DUV211
Single line sync serial interface. Complete modem control for full or half duplex operation. Provides all features of DEC Unibus DUP11-D, including on board hardware CRC or LRC checking and generation for Bit Oriented Protocols SDLHC, ADCCP and RDLC. Also Byte Protocols BYSYNC and DDCMP. × 25 capability. $950.

MLSI-DZ11A
Asyn-8-line EIA multiplexor. Provides all features of the DEC Unibus DZ-11-A plus each line has programmable character formats and data rates from 50 to 19.2K baud. Switch selectable device addressing and interrupt vectors. Includes dataset control. 4 level interrupt. Contains a 64 character buffer with a 16 character SILO counter. $1750.

MLSI-DZ11-AC
Asyn-8-line multiplexor with combined EIA/20 mA capability on a per line basis (provides operational features of DEC Unibus DZ11-A and DZ11-C within a single board). $1900.

DZ11-B
Asyn-8-line multiplexer module. Provides all features of the DEC Unibus DZ11-B plus each line has programmable character formats and data rates of 50 to 19.2K baud. $1350.

DZ11-E
Asyn-6-line multiplexer. Provides all features of DEC Unibus DZ11-E plus individually programmable character formats and data rates for each EIA line from 50 to 19.2K baud. $2800.

47-102 Programmable Asyn Single Line Adapter (PASLA)
For use with P-E asyn data sets or local RS232-C terminals. Switch selectable functions include device address, high and low baud rates and half/full duplex operation. 16 selectable, crystal controlled, rates from 50 to 19.2K baud. $450.

47-102D
Dual programmable asyn single line adapter (dual PASLA) for use with async data sets or local RS232-C terminals. Each channel has independent switch selectable functions. Either channel may be strapped for 20mA current loop operation. $625.

47-102DDL
RS422 long line option contained on Dual PASLA. Strap selectable RS422 differential driver/receiver to drive local terminals up to 4,000'. Includes strapping for both channels. Requires MDB-47-102D. $50.

48-024
Current loop/RS232-C interface for local TTY or terminals. Switch selectable functions include device address, baud rate, character format and 20 mA/RS232-C operation. 16 selectable, crystal controlled, rates from 50 to 19.2K baud. $350.

48-000
Universal clock module to provide a precision interval clock interrupt that is program selectable from one µs to 4,095 sec. $650.

48-012
Line frequency clock module to provide interrupts at a 120 Hz rate that is derived from the 60 Hz AC power line frequency. $225.

MBl-49-TTY/Rs232 Asyn Serial Interface Module.

MBl-TTY-25-A 25' Cable
Operates with most devices with a serial 20 mA current loop interface. Device end of cable has transmit and receive leads. Board end of cable is pre-configured to allow data transmission/reception between the device and the TTY/RS232 Adapter. $52.

MBl-TTY-25-B
Similar to cable above, but pre-configured to allow BUSY monitor circuit to operate with devices that signify BUSY by the absence of current in their transmit circuit. $52.

MBl-EIA-25
25' general purpose RS-232 cable has a male DB-25P EIA type connector on the device end. Interlock circuitry allows monitoring of BUSY signal on pin 20 (Data Terminal Ready) of device. $70.

MBl-EIA-25-A
25' RS-232 cable for TI 810 printers that have the DNB option enabled and have an RS-232 interface installed. $70.

MBl-EIA-25-B
Similar to cable MBl-EIA-25-A, but designed for Centronics printers that have an EIA interface installed. $70.

MBl-EIA-25-C
Similar to cable MBl-EIA-25-B, but used with Teletype Model 40 printer with simplified EIA-like interface. $70. All above RTFM, 1 yr warranty. MBl Systems Inc. Orange, CA.

Microconnection

GPIB11-V 2 DEC Q-bus to IEEE-488 Highspeed DMA Interface
Implements talker, listener and controller functions. Dual height board. Data transfer rates up to 250 kB/sec. Allows use of the IEEE-488 as an interflops communication link. SW is provided which may be installed as a handler in RT-11, RSX-11 or UNIX operating systems.

GPIB11-2/VX
Interfaces DEC VAX computer to IEEE-488 Bus via DMA channel. Same as GPIB 11-2 except comes with VAX driver package compat. with VAX/VMS operating system. $2495.

GPIB11-1
Interfaces DEC Q-bus computers to the IEEE-488 Bus. $695.

GPIB11-1
Interfaces DEC Unibus computers to the IEEE-488 bus. $1295.

GPIB11-2
Interfaces DEC Unibus computers to IEEE-488 via DMA channel. 6 high board. Data transfer rates of up to 500 kB/sec allow use of IEEE-488 as an interflops communication link. SW provided which may be installed as a handler in RT-11, RSX-11, UNIX and VAX/VMS operating systems. $1995.
**Controllers**

**TC11**
Tape Drive Controller For UNIBUS Systems.

**TC01**
Tape Drive Controller For Q-BUS Systems.

**SC11/BX**
SMD hard disk drive controller for UNIBUS systems.

**SC01**
Disk drive SMD controller for Q-BUS systems: Vend maint. 4 FO.

**FLEX02**
RX02 Compatible Floppy Disk Controller/System. FLEX02 controller is single, dual wide card for DEC LSI-11, providing up to 2.05 MB of storage: $1220-3510.

**WINC 08**
Winchell disk controller/system for the DEC LSI-11 and PDP-11. Features emulation of the LRO2, providing software compatibility with a total storage capacity of 41.6 MB. $3130-$7075.

**STORM 25**
Single board controller provides emulation of DEC's RMO2/05. Hex board compatible with standard PDP-11 SPC slot allowing attachment of up to 4 industry standard 80/300 MB SMD Drives: $4925: Vend maint. 2 FO.

**5287 Printer Controller**
Allows any RS232C or parallel printer to be attached to IBM 3274/6 cluster controllers (BSC, SDLC or SNA/SDL): Vend maint. 2 FO.

**8800 Series Micom Concentrators**
A family of modern multiplexers in a single unit. $1950 for a 4 channel mux w/a 2400 bps modem.

**Cabex 664 & 666 Multiplexers**
To hook remote multiple terminals through a single Bell telephone line to a central computer. $1900-$3300. Vend Maint.

**Telcom Products Inc.**
Westmont, IL.

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**SDC-DZ11 Async Multiplexers**
Programmed interface between PDP-11 & multiple local or remote asynchronous terminals. 8 or 16 line, EIA, 20mA or mixed 8 line each EIA/20mA. Programmable speeds, $1615.8-channel. Vend Maint. 7 FO.

**Local Net System 20/100**

**Local Net System 20**
Low-cost, coaxial cable local network system. 4 RS232C interface at up to 19.2 Kbps. Local Net can support up to 20,000 terminals on a single cable. $600 per terminal connection (configuration dependent). Vend Maint. multiple plans, 4 FO.

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**RayNet Network Processing Systems**
Single host/single protocol; multihost/single protocol; multiple host/multiple protocol systems. Turkey multiplexing, multi-tasking systems for interactive terminal network control, independent of terminal or host manufacturer. Vend Maint.

**NDLV-11 Serial Line Unit**
Comppt with DLV-11, switch selected address & speed lines, asyn serial line unit. $265.

**NDLV11 J/2**
2 port serial line unit. SW compat. w/DLV11 J, 2 independent serial line ports, baud rates to 19,200. $295.

**T-Comm 80 Communications Processor**
The system supports terminals and hosts from any number of manufacturers, and mix any number of data and voice comm. lines. True natural network control. $50,000 to $150,000. Vend Maint. 7 FO.

**Raytheon Data Systems**
Norwood, MA.

**NDLV11-E**
Serial line unit with modern control. SW compat with DVL11-E. Full modem control, switch selectable address and line speeds. $275. Vend Maint.

**Netcom Products Inc.**
Sunnyvale, CA.

**Scientific Enterprises Inc.**
Wilsonville, OR.

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**Archinet**
Medium speed (150,000 baud) local network interface for interconnecting up to 16 P-E 16- and 32-bit minicomputers or Tektronix 4081's. Half-card Z-80 based interface handles all protocol. $1500, OEM discounts avail.

**National Instruments**
Austin, TX.

**Winchester Disk Controller**
Dual-Width, DEC LSI-11 Q-Bus module controls combination of 8" and 5 1/4" Winchester + Floppy drives; bootstrap ROM. total potential storage capacity of 160 MB. $2000.

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Controllers

Video Display Controller for DEC LSI-11 Q-Bus, VDC11
Dual width module appears to be 2 serial channels, but 2nd channel provides logic for video controller; TEK 4010 graphics incl.; emulation of QL 7 series terminal possible; $1200-$1400; RTFM.

Andromeda Systems

emulation of QL controller: TEK 1001
DEC $2000.

Dual width module appears to be 2 for DG 2803 type card readers: $4 and 8 channel muxes with Multiport device usable for Nova. Allows interfacing between Nova and DG type devices: board printer controller. Allows interfacing between Nova and DG 2803 type cards: Power PCB.

Andromeda Systems

1001 Magnetic Tape Controller for DG
Allows interfacing of Nova type systems to 800 bpi tape consoles: $2000.

1001 Card Reader Controller for DG
Allows interfacing between Nova system users and Documentation type card readers: $1300.

2803 DMA Multiplexor
Multiport device useable for Nova type software system users. Micro-programmable to meet individual OEM needs: $3900.

2803 Multiplexors for DG
4 and 8 channel muxes on-board printer controller, master port with up to 8 different baud rates: $950.

2301 Line Printer Controller for DEC
Allows interfacing between PDP 11, 8 and Centronics/Printronix type devices: $360 (OEM qty).

2301 Line Printer Controller for DG
Allows interfacing between Nova systems and Centronics/Printronix type devices: $360 (OEM qty).

2601 Disk Controller for DG
Allows interfacing between Nova systems and Diablo/Hawk/W. Dynex/Pertec/Perkin Elmer cartridge type drives: $950 (OEM qty).

3000 Disk Controller for DG
Allows interfacing of Nova-driven systems to CMD/SMID type disk drives; on-board error correction: hi-speed data handling: $1790 (OEM qty).

2320 IBM Series 1 Printer Controller
Allows interfacing of Series 1 to Centronics/Printronix type printers using standard IBM protocol: $1500; RTFM.
Ardent Computer Products.

Doobis Ferry, NY.

IF-11/9700
µp-driven controller which front ends a PDP-11 and emulates an IBM System/370 Selecto or Byte Multiplexer Channel. Principal use is operation of Xerox 9700 high-volume multi-fon printer from the PDP-11. $15,000.

IF-11/9100
IBM compat. mag tape unit for local use in conjunction with a PDP-11 computer. This µp-based system includes a Kennedy tape formatter type 9219 with Kennedy 9110 tape transport. $26,000. Vend maint. 2 FO.

Andromeda Systems

Associated Computer Consultants, Santa Barbara, CA.

Magnetic Tape Controller
Model TFC 912
800 NRZI/1600 PE bi-armed formatter takes one dual-height slot in backplane. Interfaces to LSI-11, 11/2, and 11/23 computers. Compatible with all industry standard tape drives: $2730 (OEM qty).

Magnetic Tape Controller
Model TFC 912
800 NRZI/1600 PE single board plug-in controller. Compatible with all Nova/Eclipse computers: $2500 (OEM qty).

Tape Controller Model
TFC 822
800 NRZI/1600 PE single hex card controller, µp-controlled on-board test. Compatible with all industry standard tape drives. Interfaces to all PDP-11 and VAX-11 computers: $2695 (OEM qty).

Tape Controller Model
TFC 812
800 NRZI/1600 PE bi-armed controller with system unit. Compatible with DEC's PDP-11 and VAX-11 computers. TM-11 Compatible: $3400; Vend Maint. 2 FO.

AVIV Corp., Woburn, MA.

3170 Disk Controller
Compatible with all Nova mini-computers; handles up to 4 drives; features automatic formatting, multiple sector transfer, overlapped seek and comprehensive error detection. $3100 Tape Controller
Compatible with all Nova mini-computers: 7-track NRZI format is fully IBM compatible: 9-track NRZI meets ANSI standards; features dual-density, data rate selection, and 2 and 3 character mode.

3180 Tape Controller
Nova-compatible controller with IBM-compatible format; features data rule selection, Read-after-Write check, optional dual-density and full core transfer.

Ball Computer Products, Boulder, CO.

DEC System Controller
LPC-20 plug-compatible controller/printer. Handles printers (300, 600, 900, 1200, 1500, or 1800 lpm). SW comp. w/TOPS-10, TOPS-20 OSs. Quad-board (10.8" H by 9" W by 0.875" T). Hex-board (5.062" H by 9" W by 0.875" T). Power (+5Vdc @ 4.5A). Printer systems w/(LPC-20), from $10,550 (300 lpm) to $33,500 (1800 lpm).

BDS Computer Corp., Mendocino, CA.

FLOP 02
RRXV21-compatible floppy disk controller. Bootstrap for LSI-11, dual slot PCB.

900-220
Printer controller for LSI-11 Centronics compatible, dual slot PCB.

Communication Processor CP
Bit slice co-processor for LSI-11 Q-Bus; also stand alone usable: own I/O-Bus: Applications include Comm-Controller BSC, HDLC, SDLC, X.25, FET-processor: Vend Maint. 2 FO.

Bereich Mini-Computer-Systeme, Peripher Computer System GmbH.
Munich, W. Germany.

2422 Floppy Disk Controller
$100 Bus compatible: up to 4.8, 5 1/4 or mix: single or double density diskette read: auto diskette format detect, single and double side disk drives, soft sectored: fast seek for voice coil drives: optional wait states; CP/M 2.2 operating system w/DOC included; $425; RTFM, 15 FO.

California Computer Systems Inc., Sunnyvale, CA.

Emulex Controllers
Carries a variety of Emulex tape and disk controller for systems integration.


RIMFIRE 38
Intel Multibus compatible single-board disk and tape controller for the Prism Winchester disks and formatted 1/2 inch tape drives; streaming and start/stop: $2995.

Tape Master
Intel Multibus compatible tape controller for formatted 1/2 inch streaming and start/stop tape drives: $1895; RTFM.

Computer Products Corp., Plymouth, MN.

480/Slot Saver II
4-channel, single board contains interface and communications controllers for low speed and peripheral devices used with DG and DG-emulating computers; replaces 4 DG boards: $1650.

290 SMD Controller
Fully emulates DG Series 600x series of drive controllers, mix of differing capacity drives: $3360.

DG Cartridge Disk Controller
10 MB cartridge disk controller for DG minis: $1690.

120 Magnetic Tape Controller
NRZI magnetic tape formatter/controller with Pertec industry standard interface for DG minis: $1,690.

260 Multiplexer
Asynchronous multiplexer with 8 channels individually switchable for RS232 or 20 mA and speeds to 19,200 bps: $1800.

400 Multi-Function I/O
2 consoles: real time clock: parallel line printer: 8 channels of programmable Mux: $2100.

220 Slot Saver 1
Options available include: 2 consoles: real time clock: parallel line printer reader and punch: line printer: controls devices used with DG and DG-emulating computers: $2200, full configuration.

280 Cartridge Disk Controller
20 MB cartridge disk controller features full emulation of DG 6070 series subsystems: 256 word buffer eliminates data late conditions: $1850.

130 Magnetic Tape Coupler
Supports formatted NRZI and PE drives in conventional start/stop or streaming mode: $1490.

370 DMA Line Printer
Line printer controller with direct memory access, for Nova or Eclipse minis; optional internal timer and line driver: $1200. Vend Maint.

Custom Systems, Inc., Eden Prairie, MN.
CD-6 Cartridge Tape Controller
Nova series interface for 3M HCD-75, 67 MB/cartridge drive; one slot; DMA data transfer; $1100 (OEM qty).

CQ-6 Cartridge Tape Controller
Q-Bus interface for 3M HCD-75, 67 MB per cartridge drive; dual card; $1000, (OEM qty).

CU6-Cartridge Tape Controller
UniBus interface for 3M HCD-75, 67MB per cartridge drive; Quad card-one SPC slot; DMA data transfer; RSX-11 driver sources available to users at no cost; $1000 (OEM qty); RTFM.

Cybergraphic Systems, Victoria, Australia.

VR-110 Video RAM-Intel Multibus
64 character by 1 line A/N video controller; mixed pseudo graphic and text; features blinking, video, underline; $450 (QTY 1-10).

VG-120 Video Digitizer — Intel Multibus
Video Digitizer and frame store, with spatial resolution: 320 x 256 x 6; generates 64 grey level or color; conforms to RS-170 video specs; $2995 (QTY 1-9).

VT-103 Video Terminal — Intel Multibus
64 character by 1 line video terminal on one card; Interpret ASCII command from key board port; features reverse video and blink; $945 (QTY 1-5).

QVG-120/QAF-120, Video Digitizer System for DEC Q-Bus
Video digitizer and frame store, with spatial resolution of 320 x 256 x 6; generates 256 grey or 256 color; $4999 (QTY 1-9); RTFM, Datacube, Reading, MA.

S33/C SMD Controller
Storage module drive controller for DEC's PDP-11 series computers; RP06 and extended RP06 emulation; $4410 (QTY 1).

S33/D SMD Controller
Storage module drive controller for DEC's PDP-11 series computers; RP06 emulation: $4410 (QTY 1).

C33 Disk Controller
Movinghead cartridge disk controller for DEC's PDP-11 series computers; when interfaced with one to four disk drives, it emulates DEC's RK11/RK05 disk subsystem; $1860 (QTY 1).

T34/D Tape Controller
Dual density tape controller for the PDP-11 and industry standard drives; emulates T10U/T11M11 subsystem; accommodates drives up to 100 bpi, 125 ips; NRZI only version also available; $3300 (QTY 1).

T36 Tape Controller
Single card dual-density tape controller for the PDP-11 and industry standard drives; emulates T10U/T11M11 subsystem; can accommodate drives up to 1600 bpi and 125 ips; $3300 (QTY 1).

S03/A SMD Controller
Storage module drive controller for DEC's LSI-11 series computers; RM02/RM05 emulation; $4410 (QTY 1).

S03/B SMD Controller
Storage Module Drive controller for DEC's LSI-11 series computers; RP06 and extended RP06 emulation; $4900 (QTY 1).

S03/D SMD Controller
Storage Module Drive controller for DEC's LSI-11 series computers; RP06 and extended RP06 emulation; $4900 (QTY 1).

C03 Disk Controller
Moving head cartridge disk controller for DEC's LSI-11 series computers; when interfaced with one to four disk drives, it emulates DEC's RK-11/RK05 Disk System; $1860 (QTY 1).

T03 Tape Controller
NRZI tape controller for DEC's LSI-11 series computers; when interfaced with one to four disk drives, it emulates DEC's T10U/T11M11 subsystem; $1860 (QTY 1).

T04/D Tape Controller
Dual density tape controller for the LSI-11 and industry standard drives; emulates T10U/T11M11 subsystem; can accommodate drives up to 1600 bpi, 125 ips; NRZI only version also available; $3300 (QTY 1).

S33/B SMD Controller
Storage Module Drive controller for DEC's PDP-11 series computers; RP06 and extended RP06 emulation; $4410 (QTY 1).

S03/A SMD Controller
Storage module drive controller for DEC's PDP-11 series computers; RM02/RM05 emulation; $3970 (QTY 1); RTFM, Dataram Corp, Cranbury, NJ.

DSD 4140 Flexible Disk Controller
Controller/interface board for DEC LSI-11 computers; enables OEMs who have unique requirements of space or configuration to design their own package; fully compatible with RX02 hardware; $1750 (QTY 1); Vend Maint, 2 FO, Data Systems Design Inc., San Jose, CA.

IBM Series 1 Tape Controller
Model 1050 external controller which will operate up to 4 tape drives at all speeds and densities, including 125 ips; tape system starts at $9000 (QTY 1).

Embedded Cartridge Tape Controller
Model 4511 double single board occupies one I/O slot of a DG computer and controls up to 4 cartridge disk drives; $1895 (QTY 1).

1521 Dual-Density Tape Controller
Embedded DEC LSI-11 compatible tape controller; 800/1600 bpi; 12.5-75 ips; $3000 (QTY 1), dual density.

Univac MCC Chassis Series 99060
Other Univac controllers include line printer controller, card reader controller, tape reader controller, duplexers, mag tape controller and cartridge disk controller.

Model 1520AV Dual-Density Tape Controller
Embedded DEC VAX 11/780-11/750 compatible controller; 800/1600 bpi; 12.5 to 125 ips; $3900 (QTY 1) dual-density.

Model 6520 SMD Disk Controller
Embedded Single Board DEC PDP-11/04 through 11/60 compatible controller, $4900 (QTY 1).

Model 6521 SMD Disk Controller
Embedded DEC LSI-11 Compatible Disk Controller, $4950 (QTY 1).

Model 6527 SMD Disk Controller
Embedded DEC PDP 11/70 Compatible Disk Controller.

Model 6520V SMD Disk Controller
Embedded DEC VAX 11/750 and 11/780 Compatible Disk Controller.

Model 1542 Dual Density Tape Controller
Embedded Interdata Compatible Tape Controller; 800/1600 bpi; 12.5 to 125 ips; $3600 (QTY 1), dual density.

HP Compatible Tape Controller
Model 1041 allows the user to interface up to 4 drives to HP 1000 M.E. or F computer; this external controller includes chassie, duplexers, mag tape cards, I/O cables, documentation and diagnostics; $3200 (QTY 1).

Model 1520A Dual Density Tape Controller
Embedded DEC PDP-11 Compatible Tape Controller; 800/1600 bpi; 12.5 to 125 ips; $3400 (QTY 1), dual density.
Controllers

**DG SMD Disk Controller**
Model 6512 will accommodate one or two drives to provide up to 600 MB of storage capacity; $3955 (qty 1).

**DG Mag Tape Controller**
Model 1512 is an embedded controller which will control up to 8 tape drives with any density configuration; transparent to existing DG software operating systems; $3400 (qty 1); Vend Maint, 2 FO. Datum Inc., Anaheim, CA.

**Megacore**
Add-on memory systems with custom controller added; interfaces to any computer; Vend Maint, 3 FO. Digital Data Systems, Inc. Plantation, FL.

**Shugart SA4000 Interface**
Compatible Winchester Disk Controllers
Single quad size controller interfaces up to two compatible drives to LSI-11, 11/2, 11/23; Emulations: Model DGQ401 (RK05) DGQ403 (RP02/RP03) DGQ404 (RL01/RL02); Runs under RT-11 and RSX-11 software w/DEC drivers; $2050.

**Mag Tape Coupler/DILOG Module DUM130**
Interfaces up to 2 industry std. formatted tape drives with 3 slave drives each to PDP-11 Unibus. 12.5 to 125 ips; drives either single or dual density; software-compatable with RT-11, RSX-11, RSTS, IAS. Mumps via std. tape drivers; $1695.

**LSI-11 Disk Controller/DILOG Module DG100**
Single board, quad size; emulates RK05 Disk Controller; RT-11, RSX-11 software-compatable. LSI-11, 11/2, 11/23; addressing capability to 128K words, RK05 software & media compatibility; handles to 80MB total capacity. $1525.

**LSI-11 Mass Storage Disk Controller/DILOG Module DQ200**
Interfaces LSI-11 to disk drives w/ flat cable SMD interface; handles to 500MB of on-line storage; has modified DEC RK Software Driver. DEC LSI-11, 11/2, 11/23; single board, quad size; addresses to 128KW memory. R/W in block sizes to 64KW. $2950.

**LSI-11 Tape Controller/DILOG Module DG120**
0.5" tape controller; single board, quad size. Emulates TM-11 tape controller. RT-11 RSX-11 software-compatable; handle to 4 ind. std. tape drives to 112.5 ips. DEC or IBM media compatible. $2295.

**LSI-11 Tape Controller/DILOG Module DQ130**
DQ130 interfaces to 2 ind. std. single or dual density formatted tape drives to LSI-11, 12.5 to 125 ips; emulates TM-11 controller, software-compatable w/RT 11 and RSX-11. LSI-11, 11/2, 11/23. Single board, quad size; $1695.

**Mass Storage Disk Controller/DILOG Module DGQ200**
For interfacing 8" & 14" Winchester or similar drives with flat ribbon cable (SMD) interface; emulates DEC RP02 device drivers used in RT-11 & RSX-11 software systems. LSI-11, 11/2, 11/23. Single card, quad size; $2450.

**PDP-11 Disk Controller/DILOG Module DU100**
Single-board, quad size board occupying ISP slot; controller software-compatable to RT-11, RSX-11, RSTS & IAS via PK05 software drivers. PDP-11 Unibus. RK05 media compatible (when using properly aligned 2315 disk drive), handles to 80 MB capacity. $1525.

**PDP-11 Tape Controller/DILOG Module DU120**
0.5" tape controller on single, quad size board, software-transparent to RT-11, RSX-11, RSTS, IAS and Mumps software systems via TM-11 tape drive. TM-11 software-compatable; handles to 4 ind. std. tape drives; to 112.5 ips; card draws under 3.5A from 5V; occupies 1 SPC slot. $2295.

**Mass Storage Disk Controller/DILOG Module DU202**
For interfacing 8" & 14" Winchester or similar disk drives w/ flat ribbon cable (SMD) interface; runs RP02 software driver in DEC software systems; single card, quad size board, uses under 3.5A at 5V; 500 mA at -15V. Controller comes std. w/ on-board boot-strap loader, diagnostics & auto-media-flaw compensation. $2450.

**Universal I/O Winchester Disk Controllers**
For LSI-11, 11/2, 11/23; interfaces up to two drives having proprietary I/O architecture such as BASF, IMI, PRIAM; emulations: Model DGQ411 (RK05) DGQ413 (RP02/RP03) DGQ414 (RL01/RL02); Runs RT-11 and RSX-11 software with DEC drivers; $2050.

**ANSI Interface Compatible Winchester Disk Controllers**
Interfaces up to two drives to LSI-11, 11/2, 11/23; emulations: Model DGQ421 (RK05) DGQ423 (RP02/RP03) DGQ424 (RL01/RL02); Runs RT-11 and RSX-11 operating software systems using standard DEC drivers; $2050.

**Shugart SA1000 Interface Compatible Winchester Disk Controllers**
Interfaces up to two SA1000-compatible drives to LSI-11, 11/2, 11/23; emulations: Model DGQ431 (RK05) DGQ433 (RP02/RP03) DGQ434 (RL01/RL02); Runs under RT-11 and RSX-11 software systems using standard DEC drivers; $2050.

**Seagate ST506 Interface Compatible Winchester Disk Controllers**
Interfaces up to two ST506 compatible drives to LSI-11, 11/2, 11/23; emulations: Model DGQ431 (RK05) DGQ432 (RP02/RP03) DGQ434 (RL01/RL02); Runs under RT-11 and RSX-11 software systems using standard DEC drivers; $2050.

**Model DGQ330 1/4" 3M Cartridge Magnetic Tape Coupler**
Interfaced up to two Kennedy Model 6450 tape drives to the Q-Bus of the LSI-11, 11/2, 11/23; Emulations: Model DGQ601 (RK05) DGQ604 (RL01/RL02); Controllers run under RT-11 and RSX-11 operating software systems using standard DEC drivers; $2050.

**Model DGQ320 1/4" 3M Cartridge Magnetic Tape Controller**
Interfaced up to two Kennedy Model 6450 tape drives to the Q-Bus of the LSI-11, 11/2, 11/23; Emulations: Model DGQ601 (RK05) DGQ604 (RL01/RL02); Controllers run under RT-11 and RSX-11 operating software systems using standard DEC drivers; $2050.

**Model DGQ409 Floppy Disk Controller**
Dual-wide controller interfaces up to two Shugart SA800 or SA850 equivalent drives to BUS-LSI-11, 11/2, 11/23; compatible with RX02 (DY) software drivers in RT-11 and RSX-11; RX01, RX02 media compatible. IBM 3740 format; $1195.

**Model DGQ20A SMD Interface Compatible Disk Controller**
Interfaces one or two (mix or match) SMD compatible drives with 8,300 MB capacity to LSI-11, 11/2, 11/23; handles different transfer rates, number of heads, data surfaces, capacities, etc; RP02/RP03 software; runs RT-11 RSX-11; $2775.

**Model DGQ212 Mass Storage Disk Controller**
For LSI-11, 11/2, 11/23; interfaces up to two SMD interface compatible 8" or 14" Winchester/ SMD pack/CMD cartridge drives without changing controllers; capacities 8-160 MB; runs RP02/RP03; supports soft and hard sectored disks; bootstrap for RP-11 & TM-11; automatic media flaw compensation, write protect. ECC & automatic read retry; $2950.

**SMD Interface Compatible Disk Controllers**
For LSI-11, 11/2, 11/23, interfaces two drives (mix or match) compatible with RP02/RP03 software drivers RT-11 and RSX-11; switch-selectable RK06/RK07 emulation; Model DGQ215; bad-sector mapping or automatic media flaw compensation; Q215; ECC; $2950; Vend Maint, 2 FO. DILOG, Distributed Logic Corp., Garden Grove, CA.

**FD/80**
Single/double density floppy disk controller; 8" or 5¼" Multibus compatible.

**DCS/STEP 2**
Multibus stepper motor interface. Distributed Computer Systems, Waltham, MA.

**SC01 Disk Controller**
For DEC's Q-Bus, enables you to integrate one or two SMD or Winchester disks, from 12 to 600 MB, providing every big disk subsystem feature contained on Emulex Unibus and Cache bus controllers to the LSI-11 series computers; $3950 (qty 1).

**SC21 Large Disk Controller**
For DEC's PDP-11 and VAX-11; single-board, microprocessor-based large disk controller; same basic architecture and microcode, with all the features and better performance as Emulex SC11; $5000 (qty 1); SC 21/V (for VAX): $6000.

**SC02 Disk Controller**
For DEC's LSI-11 μc; designed to match the packaging and economy of SMD small and medium capacity 8" and 14" hard disk drives; $2500-$2800 (qty 1).
**SC70/71 Large Disk Controller**
For DEC's PDP-11/70; designed for the DEC Cache Bus for maximum performance and complete software transparency; $7950 (qty 1).

**TC01 Tape Controller**
For DECS LA11/24 Bus; industry's only fully imbedded dual-density controller for use with the LSI-11, 11/2, and 11/23 CPU's; $3000 (qty 1).

**TC11 Tape Controller**
For DEC's PDP-11 Series Unibus; dual-density controller that runs virtually any tape transport on the PDP-11 Unibus; $3600 (qty 1). Vend Maint, 3 FO.

**Emulex Corp.**
Santa Ana, CA.

**2023 High Speed Paper Tape Punch Controller**
These units are similar to DEC's PAP "Typesetter-11" paper tape punch controllers used with BRPE Punch Models 11, 18 and 21 at speeds up to 110 cps; they are supplied as a complete system unit and are available with or without power supplies and punches; $1350 and up.

**2024 Line Printer Controller**
The controllers are compatible with DEC LP11, LA11 and LS11 line printers and the LXY11 printer/plotters; the controller, operating with standard DEC software, interfaces to dot matrix, impact, and electrostatic line printers operating at up to 1000 lpm; $575 and up.

**2025 Card Reader Controller**
This card reader controller is hardware and software compatible with DEC CR11/CM11/CM511 systems; operates with DEC, Document, Cardamatic, PDI, GDI and similar card readers; punched or markense cards can be read at speeds up to 600 cpm; $700.

**2031 Asynchronous Serial Line Interface**
The 2031 series are single line asynchronous serial data interfaces that provide full or half-duplex communication between a PDP-11 computer and a serial data communication device; these modules incorporate on a single board all of the features of the DL11A through E and the DL11-WA and B if the Line-Time Clock feature is not needed; units are compatible with teletypewriters, Bell-series 103, 113 and 202-type modems, and other asynchronous serial data devices; $550 and up.

**2032 Asynchronous Multiplexer**
This is a program-controlled asynchronous multiplexer that connects a PDP-11 processor to 8 or 16 asynchronous serial lines; units offer improvements over the TDECZ11 models while remaining all of the standard hardware features and software compatibility; features include automatic configuration for RS232 or current-loop operation, split transmit/receive baud rates, RS423/RS232 drivers and 19.2 KB capability, and built-in test mode connectors; $1450 and up.

**2040 Hi-Density Universal Wire-Wrap Module**
These modules offer great flexibility in the choice of the number and size of ICs used; low-profile sockets with component side Wire-Wrap pins permit standard 0.5 in. slot spacing; mounting holes for additional I/O connectors and trimpots are provided on the top edge of some modules; $63 and up.

**2041 General Device Interface**
This is a general purpose parallel interface used between a PDP-11 Unibus and a peripheral device; unit is compatible with the DR11-C operating system and diagnostic software, providing parallel transmission of 8- or 16-bit out, 16-bit in, and 6 bits of control and status information; $425.

**2081 Parallel Communications Link**
The Parallel Communications Link is a multiprocessor communications device with the capability of interfacing multiple PDP-11 computers operating under RXS-11M or DECNET in a distributed processing environment; the unit provides the same features as the DEC PCL-11B high performance computer link, including a maximum bus bandwidth or one MB/sec and error-free data communication with hardware parity and CRC error detection at a substantial reduction in space and power requirements; $4300 and up.

**2140 Hi-Density Universal Wire-Wrap Modules**
These modules offer great flexibility in the choice of the number and size of ICs used; low-profile sockets with component side Wire-Wrap pins permit standard 0.5 in. slot spacing; mounting holes for additional I/O connectors and trimpots are provided on the top edge of some modules; $63 and up.

**2153 Disk Cartridge Controller**
The disk controller provides hardware and software compatibility with DEC RKV11/RK05 systems; operates with drives having capacities of 2.5 to 20 MB; either 2315 front load or 5440 top load removable cartridge disk drives may be interfaced; operates with the full 18-bit extended address of the LSI-11/23; standard features include selectable address and interrupt vector, Bus Priority level, and 1500 or 2400 RPM disk drives; $1750 and up.

**3021 Multi-Function Peripheral Control**
The DG-compatible 3021 Series is a single board that will replace up to four I/O circuit boards; it provides a line printer control, core reader control, paper tape reader control, paper tape punch control, a real-time clock and two independent terminal interfaces; the interfaces are compatible with teletypewriters, CRT terminals and all others using standard serial data protocol, and the real-time clock is crystal controlled; $500 and up.

**3040 Hi-Density Universal Wire-Wrap Module**
This DG-compatible module offers complete flexibility in the choice of the number and size of ICs used, accommodating a maximum of 228 14-pin ICs; there is also a provision for two on-board 50-pin flat cable connectors for additional I/O connections; $345.

**3042 Universal Logic Interface**
Designed for applications where the DG processor is interfaced to special purpose front ends, one half of this module provides computer interface logic, and the other half provides universal flexibility in the choice and the number and size of ICs used; a maximum of 80 MB can be used if software protocol, and the real-time clock is crystal controlled; $522 and up.

**3052 Disk Cartridge/Diskette Control**
This control is software, hardware, and media-compatible with DEC Models 4046, 4234 and 6045 cartridge units and the Model 6030 diskette; the control module interfaces to 100 and 200 tpi and 2200 bpi 2315/5440 disk cartridge drives having capacities up to 40 MB with standard software; up to 80 MB can be used if software compatibility is not a requirement; $1200; RTFM.

GEN/COMP Inc. Canton, MA.

**Printer Controller Model 9341**
Interfaces Perkin-Elmer computers to most Data Products or Data Printer type printers; $550; RTFM.

**Magnum Tape Controller**
Connects Univac 1100 series computer.

**V3830**
Connects 3330 type disk drive to Univac 1100 series computers. Vend Maint, 3 FO.

**Interence Systems, Canoga Park, CA.**

**GRF Tape Adapter**
Interfaces STC 1900 GCR tape system to Perkin-Elmer computer; software compatible, OS and diagnostic; $2835 (qty 3-5).

**Line Printer Controller**
Line printer controller interfaces Perkin-Elmer computers to Cen­tronics DataProducts or Data Printer type printers; $550; RTFM.

**Maccord, Anaheim, CA.**

**UGF-01**
High-speed video frame grabber for PDP-11 bus; factory mainte­nance; companion to URGB-256; American/European std.; three­version 4/6/8 bits per pixel; 3:1 conversion rate at 30 MHz, ext. sync to video source; full SW control. $795 (1-4).

**UGRB-Alpha**
Color Alphanumeric Video Controller for PDP-11 bus; programm­able character density; blinking/Inverse/double height; from 10­128 characters per line; hardware scroll & light pen; up to 60 lines; ext/int sync; American/European std. $845 (1-4).

**UGRB-Alpha**
Color Alphanumeric Video Controller for LSI-11 bus; programm­able character density; blinking/Inverse/double height; from 10­128 char./line; hardware scroll & light pen; up to 60 lines; ext/int sync; American/European std. $845 (1-4).

**UGRB-GRAPH**
Variable Resolution Color graphic controller for LSI-11 bus; support zoom, pan & scroll; ext/­int sync; variable resolution 256 x 256 x 4; American/European standard; $12 x 512 x 4, 1024 x 1024; single command erase. $2520 (1-4).
### Controllers

**URGB-GRAPH**
Variable resolution color graphic controller for PDP-11 bus; support zoom, pan & scroll; ext/inline sync; variable resolution 256 x 256 x 4, 512 x 512 x 4; American/European standard: 1024 x 1024, plus more; single command erase. $1500 (1-4).

**URGB-256**
256 x 256 Color Graphic Video Controller for PDP-11 bus; 256 x 256 x 4 resolution; optional companion frame grabber; 16-level color grey scale; ext/inline sync: two boards for 256 level color; American/European std. $1675 (1-4).

**QFG-1**
High-speed Video Frame Grabber for LSI-11 Bus; companion to QRGB-256: American/European Std: three version 4/6/8 bits per pixel; conversion rate at 30 MHz; ext/inline sync to RGB video source; full SW control. $795 (1-4).

**QRGB-256**
256 x 256 color graphic video controller for LSI-11 bus; 256 x 256 x 4 resolution; optional companion frame grabber; 16-level color grey scale; ext/inline sync; two boards for 256 level color; American/European std. $1675 (1-4).

**MDC-512**
Variable resolution graphics controller for PDP-11 bus; variable resolution: ext/inline sync; 256 x 256, 512 x 512, 512 x 1024 x 256, American/European std; single command erase: vertical scroll. $1295 (1-4).

**MDC-2480**
24 x 8 alphanumeric video controller for PDP-11 bus; U & L graphic character set; access time 500 ns; support blink/inverse video; American/European std: transparent memory; ext/inline sync. $495 (1-4).

**MLSI-2480**
24 x 8 alphanumeric video controller for LSI-11 bus; support blinking/inverse video; access time 500 ns: upper/lower/graphic character set; American/European std; transparent memory, ext/inline sync. $495 (1-4).

**MDC-512**
Variable resolution graphic controller for LSI-11 bus; variable resolution: ext/inline sync: 256 x 256, 512 x 512, 512 x 1024 x 256; American/European std; single command erase: support vert. scroll. $1295 (1-4).

**FFD-1**
Quad floppy disk controller; 32K RAM on board: 1/2-sided, 1/2 density; multibus: $625

**STD-256**
256 x 256 x 1 graphics controller: multiple boards can be used for color; STD-bus: $370.

**STD-2480**
24 row x 80 column alpha numerics; STD-bus: $310.

**STD-ALPHA**
Variable format alphanumeric controller; STD-bus: $415.

**EXO-2480**
24 row x 80 column alpha numerics; Motorola Exorserx bus: $520.

**EXO-512**
512 x 256 x 1 graphics controller; Motorola Exorserx bus: $730.

**ALT-256**
256 x 256 x 1 graphics controller; S-100 bus: $415. (qty 1-4)

**ALT-512**
512 x 256 x 1 graphics controller; S-100 bus: $625. (qty 1-4).

**MAC-512**
512 x 512 x 1 graphics board; DEC Q-bus: $1360. (qty 1-4).

**FG-01**
Real time video frame grabber/digitizer; 4/6/8 bit models avail.; multibus.

**RGB-256**
256 x 256 x 4 color graphics; multibus: $1675. (qty 1-4).

**RGB-GRAPH**
512 x 512 pixel x 4 bit color graphics display controller; multibus: $2520. (qty 1-4).

**RGB-ALPHA**
Variable format color alphanumeric video controller; Multibus: $885. (qty 1-4). Vend Maint.

**Matrox Electronic Systems Ltd. Quebec, Canada**

**MDB-4016 Card Reader Controller**
For all models of Documentation, time data and other popular card readers; compatible with DG operating system and diagnostic software; jumper selectable for device address and positive or negative true card reader interface; unless otherwise specified, board will be jumpered for negative true interface: 15 foot (4.57m) cable included: $965.

**MDB-4034 Programmed I/O Line Printer Controller**
For all models of Dataproducts, Data Printer, Centronics, Prin­tronix, G.E. TermiNet and other manufacturers whose interface emulates any of the above printers; compatible with DG operating system and diagnostic software; has MDB exclusive PrinTest (TM) and Loopback features, plus LEDs to give visual indication of data lines: PrinTest feature has the capability of being operated remotely from the printer if a low-going signal is entered on a prescribed pin of the printer interface connector; DIP switch selectable addressing; furnished with 15-foot cable which contains the proper interface connector for the printer: $750.

**MDB-4034-A**
Programmed I/O line printer controller designed to operate most models of Data Printer line printers; compatible with DG operating system and diagnostic software; furnished with 15-foot cable: $995.

**MDB-42XX Data Channel (DMA) Line Printer Controller**
For all models of Dataproducts, Data Printer, Centronics, Prin­tronix, G.E. TermiNet and all other manufacturers whose interface emulates any of the above printers; compatible with DG operating system and diagnostic software; has PrinTest (TM) and Loopback features, plus LEDs to give visual indication of data lines: $1500.

**MDB-4217**
Optional Programmable Interval Timer (PIT)/Real Time Clock: this option is switch selectable to operate as a PIT or RTC. PIT operates with switch selectable frequencies of 60, 10, 100, 1K, 10K, 100K or 1 MHz; with program loaded 16 bit counter, provides interrupts at time intervals from 1 usec to 6.5K sec. RTC provides interrupts at programmed control rates of 60Hz, 10Hz, 100Hz or 1KHz; compatible with DG operating system or diagnostic software. Option to MDB-42XX data channel printer controller and MDB 4034 Programmed I/O line printer controller: $730.

**MDB-DA11-BJ High Speed Parallel DMA Interprocessor Link**
Between two PDP-11 Unibus or VAX computers with differential drivers and receivers, will operate up to 3,000 feet (914.4m) allows data transfers across 32K boundaries in blocks of up to 32K words; data transfer speeds up to 500K words per second. Selectable address, interrupt vector and bus levels provided, preset to DEC standard assignment 77241X. Compatible with DEC DR11-B and DA11-B operating and diagnostic software: $4875.

**MDB-DA11-B01**
High speed parallel DMA interprocessor link between two PDP-11 Unibus or VAX computers with differential drivers and optically isolated receivers, operates up to 1,000 feet (304.8m); allows data transfers across 32K boundaries in blocks of up to 32K words; data transfer speeds up to 500K words per second; selectable address, interrupt vector and bus levels provided, preset to DEC standard assignment 77241X; compatible with DEC DR11-B and DA11-B operating and diagnostic software: $5275.

**MDB-MLSI-DA11-B01**
High speed parallel DMA interprocessor link for use with PDP-11 Unibus and LSI-11/2 or 11/23 Q-bus computers with differential drivers and optically isolated receivers; allows data transfers across 32K boundaries in blocks of up to 32K words; data transfer speeds up to 500K words per second; selectable address, interrupt vector and bus levels provided, preset to DEC standard assignment 77241X; compatible with DEC DR11-B and DA11-B operating and diagnostic software: $4050.

**MDB-DA528**
Parallel buffered program controlled interprocessor link for use with PDP-11 Unibus computers; provides programmed control of 16-bit parallel data transfer between two PDP-11 computers: line drivers and Schmidt receivers for noise immunity; selectable address, interrupt vector and bus level, preset to DEC standard assignment 77241X; compatible with DEC DR11C operating and diagnostic software: $2495.

**MDB-LP/LSII**
Line printer controller for all popular line printers; interfaces include Centronics, Dataproducts, LA 180, G.E. TermiNet, and Houston Instrument; also operates printers emulating Centronics or Dataproducts interfaces such as Printronix, Mannesmann/Tally, Okidata, CDC, etc; compatible
with DEC LP11 or LS11 diagnostics and printer driver routines; PrinTest and Loopback features, plus LEDs to give visual indication of data lines; $750.

**MDB-LP11-A**

Line printer controller with Data Printer interface; contains all features of LP11 described above; however, interface is designed to operate exclusively with most models of printers manufactured by Data Printer; the printer must have the standard interface, not the first character interface; $1250.

**MDB-LV11**

High-speed electrostatic printer/paper tape reader for Versatec or similar emulating device; compatible with DEC LV11 operating and diagnostic software; not compatible with Versatec supplied software; $1450.

**MDB-CR11 Card Reader Controller**

For all speed versions of Documation, Truedata and other popular card readers; multiple card reader address selection standard; compatible with DEC CR11 operating and diagnostic software; $875.

**MDB-PC11 High Speed Paper Tape Reader/Punch Controller**

For popular paper tape reader/punch devices; interfaces for Remex, Digtronics, EECO, Facit and other popular makes; not compatible with DEC manufactured paper tape reader/Punches; compatible with DEC PC-11 operating and diagnostic software; $1250.

**MDB-XY11 Parallel Incremental Plotter Controller**

For Houston Instrument or CalComp 500 Series XY plotters or equivalent; multiple plotter address selection and differential drivers standard; compatible with DEC XY-11 operating and diagnostic software; $750.

**MDB-IB11A IEEE/488 Instrument Bus Controller**

Provides interface between PDP-11 computer and programmable instruments that conform to ANSI std. MC 1.1-1975/IEEE std. 488-1975; operating and programming considerations are exactly as described for DEC's IB11-A; for use with LS11 computers; $975.

**MLSI-DA11BOI**

Optically isolated parallel DMA interprocessor link between any LS11-computer and any Unibus computer (PDP-11 or VAX); all features are identical to the MSI-DA11BOI: $4050.

**MLSI-LP11 Line Printer Controller**

For all popular line printers, interfaces include Centronics, Dataproducts, LA 180, G.E. Terminet, and Houston Instrument; also operates printers emulating Centronics or Dataproducts interfaces such as Printronix, Mannesmann/Tally, Okidata, CDC, etc; four level interrupt; compatible with DEC LP11 or LS11 diagnostics and printer drivers; has PrinTest and Loopback features, plus LEDs to give visual indication of data lines; $475.

**MLSI-LP11A**

Line printer controller with Data Printer interface; contains all features of LP11 described above; however, interface is designed to operate exclusively with most models of printers manufactured by Data Printer; the printer must have the standard interface, not the first character interface; $650.

**MLSI-LV11**

High-speed electrostatic printer/plotter controller for Versatec or similar emulating device; compatible with DEC LV11 operating and diagnostic software; not compatible with Versatec supplied software; for LS11 computers; $975.

**MLSI-XYV11 Parallel Incremental Plotter Controller**

For Houston Instrument or CalComp XY plotters or equivalent; multiple plotter address selection and differential drivers standard; compatible with DEC XY-11 operating and diagnostic software; $875.

**%MBS**

Optional Hollerith to ASCII converter contained on the MDB-46-235 card reader controller; compatible with Perkin Elmer operating system and diagnostic software; $875.

**MBS-46-234**

IEEE Instrument Bus Controller (and talker/listener) includes IEEE standard receptacle on board, switch selectable device address, IEEE bus address, and IEEE bus configuration; this item is a special product that is not supported with operating system software drivers or diagnostics; $1250.

**MBS-46-488**

IBM Line Printer Controller

For all models of Centronics, Dataproducts, Data Printer, G.E. Terminet, Houston Instrument and other manufacturers whose interface emulates any of the above printers, such as Printronix, Mannesmann/Tally, Okidata, etc; compatible with IBM operating systems EDX, RPS and CPS, by emulating 4973 printer controller; switch selectable device address; can be supplied with special PROMs to allow block character printing, bar codes, plotting and other graphics when used in conjunction with programs that provide these capabilities; includes PrinTest feature; $1995.

**MDB-HP-LPC Line Printer**

For all popular line and dot matrix printers; interfaces include Centronics, Dataproducts, LA 180, GE Terminet, and Houston Instrument; also operates printers emulating Centronics or Dataproducts interfaces, such as Printronix, Mannesmann/Tally, Okidata, CDC, Documation, etc; operates under HP operating systems RTEII, III & IV; provides graphics capability to Printronix printers; $980.

**MDB Systems Inc., Orange, CA**

**MCA-1023-Multichannel Video Controller**

Board for Intel Multibus; alphanumericics and graphics capability; $695.

**Multiple RS422 Communications Board**

With modern DAA board; for Multibus; Metacomp, Inc. San Diego, CA

**TURBO-21**

Intelligent disk cache for DEC PDP-11 and VAX-11 Unibus systems; single-board add-on to the MCT EDC21 emulating disk controller increases disk subsystem throughput by eliminating up to 80% of all seek time and rotational latency; $6750 (1), $5335 (25).

**EDC23**

Singleboard emulating disk controller interfaces Perkin-Elmer 16- and 32-bit computers to four SMD-compatible disk drives; emulates the P-E PSM-16M (mass storage module) disk controller; $4700 (1), $3600 (25).

**EDEC21**

Singleboard emulating disk controller interfaces DEC PDP-11 and VAX-11 Unibus computers to four SMD-compatible disk drives; emulates the DEC RH11 controller interfaced to multiple RMI/03/05 disk drives; $3900 (1), $3082 (25).

**SMV15**

Singleboard disk controller interfaces DEC VAX-X-11P-11 and PDP-11 series Unibus computers to two SMD-compatible disk drives; supports VMS, UNIX, RT-11, RXS-11M and RSTS/E operating systems; $3000 (1), $2766 (25).

**SMC903**

Singleboard disk controller interfaces Perkin-Elmer 16- and 32-bit computers to two SMD-compatible disk drives; supports OS/16 and OS/32; $3100 (1), $2400 (25).
controllers

SMC11
Single-board disk controller interfaces DEC PDP-11 Unibus series computers to two SMD-compatible disk drives; supports RT-11, RSX-11M and RSTES/E operating systems; features automatic DMA throttle, 32-bit ECC: $3500 (1), $2766 (25).

TDC803
Single-board disk controller interfaces Perkin-Elmer 16- and 32-bit computers to two Trident-compatible disk drives; runs with OS/16 and OS/32: $2500 (1), $2200 (25).

SMC12
Single-board disk controller interfaces DG Nova or Eclipse computers to four SMD-compatible disk drives; supports RDOS, IRIS and BLIS/COBOL; features hardware ECC; dual full-sector buffering, dual-access: $3500 (1), $2766 (25).

SMC902
Single-board disk controller interfaces DG Nova and Eclipse computers to two SMD-compatible disk drives; supports RDOS, IRIS and BLIS/COBOL; features on-board RAM buffering, APL support: $3000 (1), $2371 (25).

PM-DC 11A
Controller board replaces RK11D controller for RK05; transparent to DEC OS diagnostics; support std 2.5, 5, 10 MB drives for max. formatted capacity of 20 MB storage.

PM-DC 1100
Completely transparent to DEC OS & diagnostics that support RP series controllers; for realistic expansion of RP02/03 series sub-system data base to over 538/2000 MB hard disk storage; supports up to 8 drives; disk controller interfaces PDP-11 and wide range of SMD drives — including latest Winchester minidrive modules: single hex-wide drive bin-to-pin, signal and power compatible with DEC backplanes; transparent to OS and diagnostics that support RP Series controllers: transfer rate of 1.2 µs/word, transparent ECC and multi-word DMA transfer; with selected drives, cables, DEC-compatible SW as complete disk storage subsystem.

PM-DC 1102
Disk controller for use w/ high performance CDC 9762 (or equiv.) storage module drives; PM-DC 1102 emulates: totally transparent to DEC OS & diagnostics, including Winchester minidrive modules; single hex-wide drive pin-to-pin, signal and power compatible with DEC backplanes; transparent to OS and diagnostics that support RP Series controllers: transfer rate of 1.2 µs/word, transparent ECC and multi-word DMA transfer; with selected drives, cables, DEC-compatible SW as complete disk storage subsystem.

EDC24
Single-board emulating disk controller interfaces DEC LSI-11 Qbus computers to two SMD-compatible disk drives; emulates several DEC disk subsystems including RK06 and RMX02/03/05: $3000 (1), $2352 (25).

EDC22
Single-board emulating disk controller interfaces DG Nova and Eclipse computers to four SMD-compatible disk drives; emulates the DG 6600 series (Zebra) disk subsystems: $3900 (1), $3082 (25); RTFM: MiniComputer Technology Palo Alto, CA.

MSC 8102 Video Graphics Controller
Directly drives monitor: on-board processor for alphanumeric and generation independent of the Multibus; self-contained memory: RS-170 standard composite and separate video output.

MSC 8001 Industrial Controller
Includes Z80A CPU, 4KB/8KB RAM, 1 KB-16 KB EPROM capacity, 1 RS-232C port, 48 parallel I/O lines Monolithic Systems Englewood, CO.

Hexacon Multi-Device Controller
Simultaneously controls 4 67MB disks, 4 1/2" streaming tapes and up to 8MB RAM bulk memory emulating Fixed-Head-Disk on DEC's Unibus: $6500 (qty 1). National Semiconductor/Memory Systems Santa Clara, CA.

Mark V CPU Board
Vend Maint, 2 FO. POINT 4 Data Corp. Irvine, CA.

8200 Disk/Tape Controller Combination
Single board disk and tape controller for Nova & Eclipse computers; software transparent to RDOS and AOS operating systems: $2900.

8100 Disk Controller/Multiplexor Combination
Single board disk controller and multiplexor for Nova & Eclipse computers; software transparent to RDOS & AOS operating systems: $2900.

1700 Mag Tape Adapter
Magnetic tape adapter for DG Nova & Eclipse computers; software transparent to RDOS & AOS operating systems: $2500.

4318 ALM Multiplexor
18 port multiplexor for DG Nova & Eclipse computers; software transparent to RDOS & AOS operating system: $1200.

4311 ALM Multiplexor
11 port multiplexor for DG Nova & Eclipse computers; software transparent to RDOS & AOS operating system: $1200.

6010 Disk Controller
High speed disk controller for DG Nova & Eclipse computers; software transparent to RDOS & AOS operating systems: $2900. Vend Maint, 15 FO. Quentin Research, Inc. Northbridge, CA.

Line Printer Controller Model 1200
120X line printer controller connects a Data Products or Centronics (or equiv.) line printer to Unibus of PDP-11: add-in/add-on memory, hard disk drive, controllers, also tape drives. $800.

Mag Tape Adapter, Model 1300
13XX mag tape adapter interfaces industry std. formatted tape transports to PDP-11/44 thru PDP-11/70; adapter logic completely contained on one quad board that plugs into one SPC slot of CPU. $1600.

Cartridge Disk Controller Model 1400
Provides PDP-11 users the ability to control cartridge class disk drives from manufacturers other than DEC while retaining compatibility with DEC OS SW. $2500. Rianta Electronics, Ltd. Anaheim, CA.

SA1400 Series Intelligent Controller
Controls up to 4 disk drives and floppy disk drives or 1/4-inch streaming tape cartridge; Vend Maint, 10 FO, 3 service centers. Shugart Associates, Sunnyvale, CA.

SDC-RXV21 Floppy Disk Controller
For LSI-11, -11/2, -11/23: compatible with RX01/RX02 media, IBM 3740 format and Shugart interface: single dual-wide board; diskette formatting capability: $782 (qty 1).

SIC-RKV11—LSI—11 Cartridge Disk Controller
Single quad controller board for RK05: supports combinations of industry standard 2.5MB, 5MB and 10MB drives with max formatted capacity of 20MB: completely compatible with DEC operating systems & diagnostics for RKV11: $1198 (qty 1); Vend Maint, 7 FO. Sigma Sales, Inc. Anaheim, CA.
SPECTRA 20
Multifunction Data General compatible disk/tape controller; 6060 series disk emulation, 6021 tape emulation, and hardware ECC on a single PCB; RDOS, AOS, IRIS, BLIS/COBOL; $3200 (OEM qty).

SPECTRA 10
Single function Data General compatible disk controller; RDOS, AOS, IRIS, BLIS/COBOL emulation with hardware ECC on a single PCB; $2600 (OEM qty).

SPECTRA 11
Single function DEC compatible disk controller (Emulator); $2300 (OEM qty).

SPECTRA 12
Single function DEC compatible disk controller (Emulator); $2900 (OEM qty).

SPECTRA 14
Single function Perkin Elmer compatible disk controller (Emulator); $3100 (OEM qty).

SPECTRA 21
Multifunction DEC compatible disk/tape controller; RM02, RM05, RK06/7 disk emulation and T11-10, TM-11, TS-11 tape emulation with hardware ECC on a single PCB; $3600 (OEM qty). Spectra Logic Corp., Sunnyvale, CA.

DC-16-C Disk Controller and Computer Interface
Flexible unit that connects 1-4 3330-type or 300MB/600MB Winchester disks to Interlata 5, 6, & 8/16 & 32 computers, or DEC PDP-10, 11, 15 and VAX computers, or Relm computers, or Microdata 1600, 2670 Reality computers, or Keronix computers, or Lockheed LEC-16 and MAC-16 computers, or DG Nova and Eclipse computers, Varian/Univac V-70 series computers, Honeywell Series 60 Level 6 computers, HP 2100, 21MX and 21MXE computers, or HP 3000 computers; includes computer interface, connector cables, software driver and diagnostic tapes; $4000-$8000, Vend Maint, 17 FO.

Telefile Computer Products, Inc., Irvine, CA.

uIC-11TD
LSI-11 Q-Bus compatible DMA dual controller; 32 KB RAM buffer; for both IMI-7700 series Winchester disk and DEI-3400 cartridge tape; $2995 (qty 1).

uIC-11T
LSI-11 Q-Bus compatible DMA controller; 16 KB RAM buffer; for DEI-3400 17.25MB random access 1/4 inch cartridge tape; $1995 (qty 1).

uIC-11D
LSI-11 Q-Bus compatible DMA controller; 16 KB RAM buffer; for IMI-7700 series Winchester fixed disk drive (8", 10, 20, or 40MB); $1995 (qty 1); RTFM. U.S. Design Corp., Crofton, MD.

LSI-11 Printing/Plotting. Model 125 single-board interface allows LSI-11s to use any Versatec electrostatic plotter or printer/plotters, I/O MUX, hard copy controller, vector-to-raster converter; electrically/mechanically comp. w/ PDP-11/03,-11/23, LSI-11/2,-11/23, LP-11 line printer driver; operates under DEC Direct Program Control (DPC) or DMA. $1600. Versatec, Santa Clara, CA.

VIP-201 Multiprinter Controller
DG compatible controller for three independent line printers, which can be any mix of industry-standard interfaces or the Teletype Model 40. Uses only one slot; $2400 (qty 1). Vetra Systems Corp., Melville, NY.

TC-151/TS-151
Software compatible single board embedded tape controllers and subsystems for DEC LSI-11 computers; $2450 to $11,815 (qty 1). Velle System Corp.

TC-160/TS-160
Software compatible embedded cartridge tape drive controller and subsystems for DEC LSI-11 computers; $2750 to $4700 (qty 1).

TC-170/TS-170
Software compatible embedded cartridge tape drive controller and subsystems for DEC LSI-11 computers; $2750 to $4700 (qty 1).

TC-180/TS-180
Software compatible embedded cartridge tape drive controller and subsystems for DEC PDP-11 computers; $2200 to $6800 (qty 1).

DC-220/DS-220
Software compatible single board embedded cartridge disk controller and disk subsystems for DG and DG emulating computers; $1240 to $8840 (qty 1).

DC-231/DS-231
Software compatible RM02 emulating single board embedded disk controller and subsystems for DEC PDP-11 computers; $3350 to $20,170 (qty 1).

TC-140/TS-140
Software compatible single board embedded dual density tape controller and tape subsystems for Perkin Elmer controllers; $2820 to $12,185 (qty 1).

TC-131/TS-131
Software compatible single board embedded dual density tape controller for DEC PDP-11 and VAX computers and tape subsystems; $3680 to $11,965 (qty 1).

TC-120/TS-120
Software compatible single board embedded tape controllers and tape subsystems for DG and DG emulating computers; $3410 to $12,185 (qty 1); Vend Maint, 4 Western Peripherals Div of Wespertcorp.

211 Peripheral Processor
For Unibus/SMD disk drives; provides up to 1.2 billion bytes of disk storage capacity for DEC Unibus family of computers; connects up to four SMD interface drives; $6673 (qty 1).

410 Peripheral Processor
For multibus/tape cartridge subsystems; provides up to 40 MB of online disk storage for any MultiBUS-based system; single board multibus-based system will support four 10MB drives with Diablo 44B interface; Xylogics supplies the 410 and CDC Hawk drives; $1925 (qty 1); $1435 (25-49).

440 Peripheral Processor
For multiBUS/SMD disk drives; provides up to 1.2 gigabytes of on-line disk storage for any MultiBUS-based system; two board set that can support up to 4 SMD interface drives; Xylogics supplies complete disk subsystems; $3960 (qty 1); $2995 (25-49).

510 Emulating Peripheral Processor
For Q-Bus/Cartridge disk interface DEC LSI-11 Q-Bus computers to a maximum of 4 drives that range in size from 2.5, 5 or 10MB; total capacity supported is 20 MB; Xylogics supplies CDC LSI-11 disk subsystems; $1635 (qty 1); $1215 (25-49).

530 Emulating Peripheral Processor
For Q-Bus/Winchester disk; Q-Bus compatible with DEC LSI-11 computers and supports up to 4 Winchesters allowing an on-line capacity of 41.6 MB; emulates DEC RLV11/RL01 or the RLV21/RL02; Xylogics supplies Winchester disk subsystems; $2065 (qty 1); $1540 (25-49).

550 Emulating Peripheral Processor
For SMD disk subsystems; supports up to 4.8 billion bytes of on-line disk storage on DEC LSI-11 to 12L1 and LSI-11 Q-Bus expandable to eight drives; $4950 (qty 1); $3200 (25-49).

570 Emulating Peripheral Processor
For Q-Bus cartridge tape subsystems; on-line cartridge tape storage for DEC LSI-11 based computers; the 570 runs up to two 17MB tape drives and uses all current LSI-11 operating systems and diagnostics; $1980 (qty 1); $1475 (25-49).

610 Emulating Peripheral Processor
For cartridge disk subsystems; provides up to 20MB of cartridge disk storage capacity for the DEC Unibus family of computers; the 610 supports all RK11/RK05 features, or 2.5, 5 or 10MB fixed/ removable media with optional 9090 verification; $2475; $1845 (25-49).

650 Emulating Peripheral Processor
For SMD disk subsystems; up to 4.8 billion bytes of on-line disk storage for Unibus based DEC PDP-11 or VAX-11 computers; the 650 runs up to four SMD-interface disk drives on all current PDP-11 operating systems and diagnostics; $4950 (qty 1); $3200 (25-49).

675 Emulating Peripheral Processor
Runs up to four TM11/TU10 compatible 1/2 inch industry standard tape drives (including mixed densities) on DEC PDP-11 or VAX-11 computers; the 675 runs 800 bpi (NRZ) and 1600 bpi (PE) in DEC or IBM standard packing modes using DEC operating systems and diagnostics; $3495 (qty 1); $2995 (25-49).

810 Peripheral Processor
For cartridge disk subsystems; supports up to 40MB of on-line cartridge disk storage for Nova, Eclipse, and Nova "lookalike" computers, and runs DG software and diagnostics; Xylogics can supply CDC 9427H Hawk disk drives; $1870 (qty 1); $1395 (25-49).

900 Emulating Peripheral Processor
For SMD disk subsystems; provides up to 1.2 billion bytes of on-line disk storage capacity for DG Nova and Eclipse computers; the 900 supports up to four SMD interface disk drives on RDOS, AOS, IRIS and BLIS/COBOL; $3575 (qty 1); $2665 (25-49); RTFM.

Xylogics, Inc.
Burlington, MA.
Disk Emulators

Expanda STOR-11
Semiconductor replacement for DEC's RK05 disk. SW compatible to RK11-D/RK05 system. Available as add-in or 19" rack mountable add-on. Capacity - 25 MB to 40.0MB. Expandable in 256 kB increments. (Ideal as a snapping disk.) From under $5000.0, 25MB -- $38,000.4 0MB. RTFM. Cambex Corporation, Waltham, MA.

BC-701 Memory System
256 kB to 4MB core disk emulator replacing Perkin-Elmer's M46 movinghead disk system. Off-line tester inc: 256 kB incremental memory size. $11,200.

BS-701 Memory System
512 kB to 8MB MOS/ECC disk emulator replacing Perkin-Elmer's M46 movinghead disk. 512 kB incremental memory size. off-line tester inc. $11,300.

BC-301 Memory System
256 kB to 4MB core disk emulator replacing Data General's NOVADISC. Off-line tester inc: 256 kB incremental memory size. Dual port option avail. $10,200.

BS-301 Memory System
512 kB to 4MB MOS/ECC disk emulator replacing Data General's NOVADISC. Off-line tester inc. 512 kB incremental memory size. Dual port option avail. $9730.

BC-303 Memory System
1MB to 8MB core disk emulator replacing Data General's 6063/6065 disk system. Off-line tester inc: 1MB incremental memory size. Dual port option avail. $30,000.

BS-303 Memory System
1MB to 8MB MOS/ECC disk emulator replacing Data General's 6063/6065 disk system. Off-line tester inc: 1MB incremental memory size. Dual port option avail. $15,960.

BC-301R Memory System
256 kB to 2MB core disk emulator for use with ROLM's 1602 computer. Emulates ROLM's 3340 disk system. $12,300.

BS-301R Memory System
512 kB to 4MB MOS/ECC disk emulator for use with ROLM's 1602 computer. Emulates ROLM's 3340 disk system. $12,950.

BC-316 Memory System
256 kB to 2MB core disk emulator for use with Honeywell's 316 computer. Emulates X16-931X drum storage. $11,400.

BC-316 Memory System
512 kB to 4MB of MOS/ECC disk emulator for use with Honeywell's 316 computer. Emulates X16-931X drum storage. $12,030.

BC-901 Memory System
256 kB to 2MB core storage module drive emulation for use with any controller with SMD interface. $9,900.

BS-901 Memory System
512 kB to 8MB of MOS/ECC storage module drive emulation for use with any controller with SMD interface. $9730.

BC-212 Memory System
256 kB to 4MB core RF-11 disk emulator for DEC'S LSI-11 series computer. 256 kB incremental memory size: off-line tester inc. $10,900.

BC-214 Memory System
512 kB to 8MB core RJS03/04 disk emulator for DEC'S LSI-11 series computer. 512 kB incremental memory size, inc. $16,900.

BS-212 Memory System
512 kB to 4MB MOS/ECC RF-11 disk emulator for DEC'S LSI-11 series computers. 512 kB incremental memory size: off-line tester, error log for ECC inc. $10,330.

BS-214 Memory System
512 kB to 8MB MOS/ECC RJS03/04 disk emulator for DEC'S LSI-11 series computers. 512 kB incremental memory size: off-line tester, error log for ECC inc. $10,330.

BC-202 Memory System
256 kB to 4MB core RF-11 disk emulator for DEC'S PDP-11 series computer. 256 kB incremental memory size: off-line tester inc. $10,100.

BC-204 Memory System
512 kB to 8MB core RJS03/04 disk emulator for DEC'S PDP-11 series computer. 512 kB incremental memory size: off-line tester inc. $16,000.

BS-202 Memory System
512 kB to 4MB MOS/ECC RF-11 disk emulator for DEC'S PDP-11 series computer. 512 kB incremental memory size: off-line tester, error log for ECC inc. $9,530.

BS-204 Memory System
512 kB to 8MB MOS/ECC RJS03/04 disk emulator for DEC'S PDP-11 series computers. 512 kB incremental memory size: off-line tester, error log for ECC inc. $9,530.

BS-200DP Memory System
512 kB to 8MB of dual port MOS/ECC disk emulation for DEC'S LSI-11, PDP-11 and custom I/O for data acquisition, array processors, etc: off-line tester, error log for ECC inc. $13,830.

BC-200DP Memory System
256 kB to 8MB of dual port core disk emulation for DEC'S LSI-11, PDP-11 and custom I/O's for data acquisition, array processors, etc: off-line tester inc. $17,500.

BC-205 Memory System
512 kB to 2.0MB core RF-15 disk emulator for DEC'S PDP-15 computer. 512 kB incremental memory size. Off-line tester inc. $20,000.

BS-205 Memory System
512 kB to 4.0MB MOS/ECC RF-15 disk emulator for DEC'S PDP-15 computer. 512 kB incremental memory size: off-line tester, error log for ECC inc. $13,830. RTFM.

SDV11
LSI-11 semiconductor disk emulator. Direct access storage device 256 kB to 2MB of storage in 256 kB increments. $3,750 in single quantities: $2,437.50 in quantities of 100. Vend main: General Robotics Corp., Hartford, WI.

MaxiRAM-11/70HS
Attaches to high speed cache bus of PDP-11/70 computer emulates fixed-head disk. Avail. with core or semiconductor memory modules. Solid State.

MaxiRAM-RV77
Attaches to direct data channel of Sperry Univac (Varian) V70 series of minicomputers. Avail. with core or semiconductor memory modules. Solid State.

MaxiRAM-20, MaxiRAM-S20
Attaches to I/O bus of Data General Nova and Eclipse computers, emulates fixed-head disc. Avail. with either core or semiconductor memory modules. Solid State.

MaxiRAM-11, MaxiRAM-S11
Attaches to Unibus of any PDP-11 computer, emulates a fixed-head disk. Avail. with core or semiconductor memory modules. Solid State.

MaxiRAM-25, MaxiRAM-S25
Attaches to I/O bus of a Westinghouse W2500 computer, emulates fixed-head disk. Avail. with either core or semiconductor memory modules.

Imperial Technology Inc.
El Segundo, CA.

PM-RFV11
Fixed-head disk emulator, for fast swapping on TSX OS or RMX-11M. 500 kBs, transfer rate w/ 4ms access time; quad-wide controller board w/ 256 kB memory board can interface with max. 7 PM-RMV11 memory modules for 2MB capacity.

PM-RF11
Fixed head disk emulator provides high-speed bulk storage (to 1.5 MB): 16K MOS RAMS; ECC: no moving parts; for interactive applications, use as a swapping file (increases throughput); data transfer speed: 1 to 2 µS/w; access time under 1 µS. 1 PO.

Plessey Peripheral System.
Irvine, CA.

Next Month . . .

Part II of this directory will cover:
Display Terminals, Flexible Disk Drives, Packaging/Hardware/Backplanes/Enclosures, Printers & Plotters, Rigid Disk Drives, Services, Software, Special I/O's, Tape Systems, Test Equipment/Instrumentation, and Other.
List of Manufacturers

suppliers of computer compatible products

This alphabetical listing of computer compatible product manufacturers includes names, addresses, phone numbers and sales contacts. All companies cited in the Compat Directory Part I, as well as those that will be included in September's Compat Directory Part II, are listed here for your convenience.

A

Ray Ball
Able Computer
1751 Langley Ave.
Irvine, CA 92714
(714) 979-7030

Allen L. Pollens
ADAC Corp.
70 Tower Office Park
Woburn, MA 01801
(617) 935-6668

John H. Meyn
Adams Russell
Digital Processing Div.
1370 Main St.
Waltham, MA 02154
(617) 891-4700

Tamsie Honey
Advanced Business Technology Inc.
12333 Saratoga-Sunnyvale Rd.
Saratoga, CA 95070
(408) 446-2013

K.J. Scannell, Vince Maturro
Advanced Digital Products
7584 Trade St.
San Diego, CA 92121
(714) 578-9505

Gary Wilson
Advanced Electronics Design Inc.
440 Potrero Ave.
Sunnyvale, CA 94086
(408) 733-3555

John Rademaker
Agile Corp.
1050 Stewart Dr.
Sunnyvale, CA 94086
(800) 538-1634

William Alden
Alden Computer Systems
23 Strathmore Rd.
Natick, MA 01760
(617) 655-6610

Nigel R. Spicer
Alloy Engineering Co., Inc.,
Computer Products Div.
12 Mercer Rd.
Natick, MA 01760
(617) 655-3900

Barbara Currall
Alphacom Inc.
2323 So. Bascom Ave.
Campbell, CA 95008
(408) 559-8000

D. Curtiss Johnson
Alpha Data Inc.
20750 Marilta St.
Chatsworth, CA 91311
(213) 882-6500

Richard F. Rohrev
Alphamatrix Inc.
1021 Millcreek Dr.
Langhorne, PA 19047
(215) 355-3297

Robert Sillers
Darrell Sprague
Alternatives in Magnetics
25431 Rye Canyon Rd.
Valencia, CA 91355
(805) 257-2262

Linda Taylor
American National Supply Corp. (ANSCO)
Box 2259
Gardena, CA 90247
(800) 421-1270

Jim Snow
Amlyn Corp.
1738-H Junction Ave.
San Jose, CA 95112
(408) 275-8616

John Jory
Ampex Corp., Memory Products Div.
200 N. Nash
El Segundo, CA 90245
(213) 640-0150

John Kim
Amtek Business Machines Inc.
2255-H Martin Ave.
Santa Clara, CA 95050
(408) 727-1510

Rich McMahon
AMT Software Systems
183 Guggins
Boxboro, MA 01719
(617) 263-3030

John Knox
Anadex Inc.
9825 DeSoto Ave.
Chatsworth, CA 91311
(213) 998-8010

Les Silvern
Box 280
Norwood, MA 02062
(617) 329-4700

Jim Lawrence
Analog Technology Corp.
15859 E. Edna Place
Irwindale, CA 91706
(213) 960-4004

Linda Rioux
Analog Corp., Data Acquisition & Conversion Products
Audubon Rd.
Wakefield, MA 01880
(617) 246-0300

Will Alger
Andromeda Systems Inc.
9000 Eton Ave.
Canoga Park, CA 91304
(213) 709-7600

Sarah Freeman
Ann Arbor Terminals Inc.
6175 Jackson Rd.
Ann Arbor, MI 48103
(313) 663-8000

Elizabeth Farebee
Applied Information Systems Inc.
500 Eastowne Dr., Suite 207
Chapel Hill, NC 27514
(919) 942-7801

Art Garofalo
Ardent Computer Products
145 Palisades St.
Dobbs Ferry, NY 10522
(914) 692-6900

Sheldon Hess
Associated Computer Consultants
228 E. Cota St.
Santa Barbara CA 93101
(805) 963-8801
## List of Manufacturers

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>Phone Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS Computer Corp.</td>
<td>1120 Crane Street, Menlo Park, CA 94025</td>
<td>(415) 326-2115</td>
</tr>
<tr>
<td>John McPhail, Ron Hardy</td>
<td>Beehive International</td>
<td>4910 Amelia Earhart Dr., Salt Lake City, UT 84125</td>
</tr>
<tr>
<td>D. Bellin</td>
<td>Bellin Computer Systems Inc.</td>
<td>206 Terminal Dr., Plainview, NY 11803</td>
</tr>
<tr>
<td>Stephen F. Grande</td>
<td>Best &amp; Midcom Data Systems</td>
<td>1940 N. Tustin, Suite 117, Orange, CA 92665</td>
</tr>
<tr>
<td>Bill White</td>
<td>Bill White Printed Circuit Design</td>
<td>1106 S. Ambridge St., Anaheim, CA 92806</td>
</tr>
<tr>
<td>Steve Lipsey</td>
<td>Bolt Beranek and Newman Inc. (BBN), Computer Systems Div.</td>
<td>10 Moulton Street, Cambridge, MA 02238</td>
</tr>
<tr>
<td>Roger O’ Holland</td>
<td>Cabeshare Ltd.</td>
<td>20 Enterprise Dr., London, Ontario N6A4L5 Canada</td>
</tr>
<tr>
<td>Brett Benson</td>
<td>Tammy Benson California Communications</td>
<td>8405 Pershing Dr, #401, Playa del Rey, CA 90291</td>
</tr>
<tr>
<td>Zeer Rote</td>
<td>California Computer Group</td>
<td>3303 Harbor Blvd, #K-11, Costa Mesa, CA 92626</td>
</tr>
<tr>
<td>Dave Hall</td>
<td>California Computer Products Inc.</td>
<td>2411 W. La Palma Ave., Anaheim, CA 92801</td>
</tr>
<tr>
<td>C. A. Williams, Jr.</td>
<td>BST Consultants Inc. BST Data Systems Inc.</td>
<td>Box 23425, Tampa, FL 33623</td>
</tr>
<tr>
<td>R. L. Nelson</td>
<td>Bubbly-Tec Div. 6800 Sierra Court, Dublin, CA 94566</td>
<td>(415) 829-8705</td>
</tr>
<tr>
<td>Matthew Goldback</td>
<td>California Dataline</td>
<td>2770 E. Regal Park Dr. Anaheim, CA 92806</td>
</tr>
<tr>
<td>L. E. Thompson</td>
<td>California Instruments, Division of Norlin Industries</td>
<td>5150 Convoy St., San Diego, CA 92111</td>
</tr>
</tbody>
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### C

<table>
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<th>Phone Numbers</th>
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<td>California Instruments, Division of Norlin Industries</td>
<td>5150 Convoy St., San Diego, CA 92111</td>
</tr>
<tr>
<td>David Gellatly</td>
<td>Callan Data Systems</td>
<td>2637 Townsgate Rd., Westlake Village, CA 91361</td>
</tr>
<tr>
<td>John Robinson</td>
<td>Cambex Corp.</td>
<td>360 Second Ave., Waltham, MA 02154</td>
</tr>
<tr>
<td>Walter Hodge</td>
<td>Charles River Data Systems Inc.</td>
<td>4 Tech Circle, Natick, MA 01760</td>
</tr>
<tr>
<td>John Ross</td>
<td>Chrislin Ind. Inc.</td>
<td>31352 Via Colinas, Westlake, CA 91362</td>
</tr>
<tr>
<td>Lowell Coulson</td>
<td>Chromatics Inc.</td>
<td>2558 Mountain Industrial Blvd., Tucker, GA 30084</td>
</tr>
<tr>
<td>Ed Kramer</td>
<td>Cibi-Honeywell-Bull (Bull Corp. of America)</td>
<td>200 Smith St., Waltham, MA 02154</td>
</tr>
<tr>
<td>Allan R. Clyde</td>
<td>Clyde Digital Systems, Div. of Clyde Enterprises</td>
<td>Box 348, Bedford, MA 01730</td>
</tr>
<tr>
<td>Peter Alexander</td>
<td>CNR Inc., Computer Products Div.</td>
<td>220 Reservoir St., Needham, MA 02194</td>
</tr>
</tbody>
</table>
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Digi-Data Corp.
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Marie Stokes
Digital Pathways Inc.
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(415) 969-7600

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F

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Don Venable
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(206) 881-7544

Dennis Resnik
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(213) 709-3300

Microsignal
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(805) 687-8608

Oscar Rosenbloom
Microtech Exports
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Palo Alto, CA 94301
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Seth Basker
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Seattle, WA 98199
(206) 282-1170

Ken Salz
North Atlantic Industries, ACS Div.
60 Plant Ave.
Hauppauge, NY 11787
(516) 582-6500

Robert Reiss, Dorothy Sprague
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25433 Rye Canyon Rd.
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(213) 250-2050

Bruce P. Almich
Nassau Systems, DEC Compatible Hardware Accessories
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Cincinnati, OH 45219
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OPTO 22
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(408) 732-0656

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90 W. Germany
0 89/68 1021

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<thead>
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<th>Name</th>
<th>Address</th>
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<tbody>
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<td>Spatial Data Systems</td>
<td>(805) 967-2383</td>
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<tr>
<td></td>
<td>Box 978</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Goleta, CA 93116</td>
<td></td>
</tr>
<tr>
<td>Robert Carter</td>
<td>Spectra Logic Corp.</td>
<td>(408) 744-0930</td>
</tr>
<tr>
<td></td>
<td>1227 Innsbruck Dr.</td>
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<td></td>
<td>Sunnyvale, CA 94086</td>
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<tr>
<td>Helen T. Havensat</td>
<td>Spectrogram Corp.</td>
<td>(203) 281-0121</td>
</tr>
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<td></td>
<td>385 State St.</td>
<td></td>
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<tr>
<td></td>
<td>North Haven, CT 06473</td>
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<tr>
<td>Dan Janzen</td>
<td>Standard Engineering Corp.</td>
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<tr>
<td></td>
<td>44800 Industrial Dr.</td>
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<td></td>
<td>Fremont, CA 94538</td>
<td>(415) 657-7555</td>
</tr>
<tr>
<td>David Jorgensen</td>
<td>Ron Rader, Joe Vallerend</td>
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<td>Stanford Applied</td>
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Computer Compatible Questionnaire

If your firm manufactures compatible memories, peripherals or equipment for DEC, Data General and other computers, then let our 67,000 direct (198,000 total) readers know. Send us all the product literature you’ve got. Please place one product per page (make photocopies as desired). Give brief description and important specs. Please do not write, “See Spec Sheet,” we cannot reprint spec sheets.

Category (for this product)
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- [ ] Array Processor
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Description/specs _______________________________ 

This product is compatible with? ______ DEC, ______ DG, ______ P-E, ______ HP, ______ Intel, ______ Other

Price(s) _________________________________ 

Do you □ manufacture? □ wholesale? □ service? □ other? describe ________________ 

Check type(s) of maintenance available:
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AUGUST 1981 Digital Design 95
Flywheel UPS Produces 60 Hz At Any Speed

Usually, technology developed as a result of the computer industry trickles down to augment established, existing technologies. Rarely, however, this course reverses, and an established, existing technology is rediscovered that is uniquely suited to computer applications.

John Roesel’s variable-speed, constant-frequency (VSCF) generator, developed in the early ’70s, provides continuous 60-Hz power, whether the input comes from the utility company or a lawn mower engine. This precisely controlled power is just what today’s computer systems require, and Continental, “an international packaging, forest products, insurance and energy company,” recently acquired the license for the technology and added “manufacturer of uninterruptible power supplies” to their title.

100% output isolation
Continental calls their line of uninterruptible power supplies (UPS) “PoweRotor,” and claims the units have a number of advantages over existing UPSs. First of all, their power input is 100% isolated from their power output, thereby eliminating power spikes, dips, and transient noise caused by lightning, utility switching, large load changes and utility equipment malfunctions. Second, PoweRotor provides from 10 to 30 seconds of ride-through power in the event of a power outage. In the case of an outage longer than this, PoweRotor generates the power necessary to effect an orderly shutdown of computer systems or startup of a stand-by source. Third, Continental claims five times the MTBF of static inverter/battery systems, crediting low power electronics and simple construction for PoweRotor’s long life and low maintenance.

exciter prints poles
Central to the PoweRotor VSCF generator is the exciter head coil (Figure 2), which is “essentially like a big tape recorder write head,” according to Bradley Walter, Continental Vice President of Marketing. Revolving around it is the rotor drum, a high density flywheel “lined with material generically similar to the oxide on tape recorder recording tape.”

As the inductance part of a tuned inductance/capacitance resonant circuit, the exciter head “prints” north and south poles on the 800-lb, revolving barium-ferrite drum. A crystal oscillator insures that these poles are printed at precisely 120 poles per second. Therefore, if the rotor spins at 1800 rpm, it’s a four-pole magnet, each pole occupying one-fourth of its circumference (Figure 3). At 3600 rpm (PoweRotor’s standard rate), the exciter head prints two poles per revolution, each extending halfway around the rotor’s surface.

Generator coils occupy the periphery of the “stator,” which is the stationary center of the generator. Regardless of rotor speed, these coils “see” the same number of poles per second, thanks to the constant printing rate of the exciter head. Frequency (Hz) equals the number of poles times rpm over 120; with PoweRotor, the number of poles increases as rpm decreases, and vice versa, so frequency remains constant.

blackout protection
During a power outage, PoweRotor’s magnetic flywheel provides smooth power for 10 to 30 seconds, depending on load. “Most power problems are of short-term duration,” says Walter. “Ten seconds of ride-through time will solve 98% or 99% of all the power problems that are outside a computer system.”
Now there's an advanced technology family of single board controllers for DEC* computers from Western Peripherals—the number one name in controllers.

The TC-131 (for PDP-11s*) is the first TM-11 emulating controller to combine PE and NRZ on one standard hex board. It lets you mix 9-track, PE, NRZ or dual density tape units in any combination up to 125 ips. A 64 byte data buffer allows installation at any point on the unibus without consideration of NPR priority.

The TC-151 single board NRZI tape controller interfaces any industry-standard drive to the LSI-11~. Add a dual width Phase Encode Board for the same performance as the TC-131.

The DC-231 accommodates up to four SMD disc drives of 40 to 600 mb each with RMO2 emulation. Its four sector (2048 bytes) data buffer makes “data-late” errors a thing of the past. The advanced technology “micro-engine” allows a complete track to be written on a single drive revolution. A measurable performance advantage for your PDP-11.

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The full standard ASCII 96 character set, with descendents and underlining of all upper and lower case letters, is printed bi-directionally, with up to 5 crisp copies, at speeds up to 200 CPS. Models DP-9500 and DP-9501 offer 132/158/176 and 132/165/198/220 columns respectively. Print densities are switch- or data-source selectable from 10 to 16.7 characters/inch. All characters can be printed double-width under communications command.

Interface Plus
Standard in all models are the three ASCII compatible interfaces (Parallel, RS-232-C, and Current Loop). Also standard is a sophisticated communications interface to control Vertical Spacing, Form Length and Width, Skip-Over Perforation, Auto Line Feed, X-On/OFF, and full point-to-point communications.

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As standard, each model features forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing, full self-test, 700 character FIFO buffer (with an additional 2048 characters, optional), and a quick-change, 6 million character life ribbon.

Quality Plus
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system. Plus we get rid of all frequency deviations — in this country that’s not too much of a problem, but in other countries it’s a very bad problem."

But is ten seconds enough time to prepare for an unexpected, long-term blackout? "Ten seconds," answers Walter, "on the size computer we’re aimed at... is a lifetime. They can get themselves stopped in an orderly manner so that when the power comes up they can essentially start up in a couple of seconds, and start processing from the next instruction from where they left off."

For computer systems that must never go down, even during long-term blackouts, PoweRotor still provides a solution. "When we designed PoweRotor," explains Walter, "we chose ten seconds of ride-through because you can couple this with one of the fast-start diesels that will be up and can supply load to our PoweRotor machine in less than ten seconds. Now you wouldn’t have that diesel up and supplying load directly to your computer, because the frequency might not be stabilized in ten seconds. (With PoweRotor) we don’t care if the frequency is stabilized — that thing can be wobbling all over the place, as long as it’s putting out kilowatts."

MTBF improved

Continental estimates their unit’s MTBF at over 100K hours. Competing static inverter/battery systems, according to Walter, provide under 20K hours. This is lower than battery system company specs, but Walter claims that "they get higher MTBF figures because they use a static switch... that switches you back to a regular power line. They don’t count that as a failure, but now I’m running barefoot, because they’re not providing the service I want them to provide. I call it a failure when it ceases to provide conditioned power. That’s a failure — it isn’t operating the way it’s supposed to be operating."

Other problems Walter cites for static inverter/battery systems are sensitivity to high temperatures and tighter government regulations on installation in major urban areas, requiring separate ventilation systems and fire extinguishers.

Regarding other motor generator sets, Walter claims that during a power outage, they can’t provide enough ride-through time to stop computer operations in an orderly manner, or to start a standby source. Even units with flywheels, he says, can provide only about one second of ride-through power.

other applications

According to John Roese!, President of Precise Power Corp (Bradenton, FL) and inventor of the VSCF generator, computer system UPSs are merely the latest application of a multi-functional technology. "We began development in the early ‘70s and brought the initial products out in 1976," explains Roese!.. These were primarily motor generator sets for military applications, using the generator’s constant frequency, variable speed capability. "The latest twist in the technology is, according to Roese!, "the application of this same technology in the variable speed motor market, which is essential-

Continental’s interest is currently limited to UPSs, and they now offer two models: Model A7-603 is rated at 7.5 KVA; output is 120/208 VAC, 3-phase, 60 Hz. Single-quantity cost is $19,950. Model A3-601 is 4.5 KVA, 120 VAC, single-phase, 60 Hz, and is priced at $9,975. Both produce frequency accuracy of 0.025%.

Continental is planning sizes now up to at least 35 KVA."

--- by Bob Hirshon

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Retro-Graphics Enhances VDTs

What started only three years ago as an idea to convert alphanumeric terminals into versatile graphics displays has proliferated into a million-dollar technology called Retro-Graphics. First introduced by Digital Engineering for the Lear Siegler ADM Dumb Terminal Display Series, the Retro-Graphics enhancement was expanded in September of 1980 to include the DEC VT-100 Video Display Terminal.

The idea is simple. By plugging a generically designed discrete/IC/RAM PC card into your much-used, but limited, alphanumeric terminal, you transform it into a graphics workhorse capable of creating the most complicated concepts — point plots, vector drawings, pie and bar charts, and even complex mappings and curves. Retro-Graphics allows you to continue to generate the same text you did before.

With Retro-Graphics you can now have an emulation of Tektronix’s popular 4010 Series of graphics terminals. Not only does this new capability include such features as standard-to-medium resolution, flicker-free imagery, selective erase, high light output, and alphanumeric overlay, but Retro-Graphics provides compatibility with such standard graphics software as ISSCO’s Displa and Tellagraf, and Tektronix’s PLOT 10. Price is approximately half of what it costs for a comparably equipped terminal.

light-pen option

To further enhance Retro-Graphics-equipped terminals, Digital Engineering is now offering a light-pen as an efficient “pointing” device for interactive graphics applications. Like the Retro-Graphics standard cross-hair cursor, the light-pen allows the terminal to emulate the widely used Tektronix 4010 Graphic Input Mode. As a result, a Retro-Graphics-enhanced VT-100 terminal with light-pen is compatible with existing software written for this mode. Easily connected to a Retro-Graphics-updated DEC VT-100 terminal by means of a rear-panel assembly, the light-pen option allows an operator to point at a CRT raster screen and transmit X-Y coordinates directly into computer memory. In contrast to other types of interactive devices (thumb wheels and bit pads, for example), the pen is both rapid, convenient, and easy to use.

To operate the light-pen, the front tip containing a sensor is lightly touched by the user or pressed against the CRT display. When the phosphor directly behind the point to be recorded is illuminated by the raster scan of the CRT’s electron gun, the sensor is triggered and a signal containing the X-Y coordinates of the point is recorded.

With both the Retro-Graphics enhancement and the newly introduced light-pen, DEC VT-100 terminal owners now have the means of executing almost any interactive graphics application. A typical example would be a series of programs that offer possibilities for a “menu” selection, each subject of which is positioned on the screen by the terminal operator.

Digital Engineering’s newest additions to the computer user’s graphics capability — the VT-20-LPN light-pen and VT-SX-PI series printer interface — are now available as optional items for the Retro-Graphics-enhanced DEC VT-100 terminal.

printer interface

Digital Engineering is also introducing a printer-interface option which, like the light-pen, is easily attached to a DEC VT-100 terminal through a rear-panel assembly. This interface supports a number of graphics and non-graphics printers now on the market.

Basically, the printer interface operates in two modes — Alpha and Graphics. In the Alpha mode (for on-line alphanumeric printing), the interface is transparent to transmission from the terminal to the printer, with all characters received by the terminal sent directly to the printer. In the event the host computer is transmitting faster than the printer can accept data, the user can enable a special protocol to eliminate data loss and maintain maximum throughput.

If the printer being used has a graphics capability, the interface allows the Graphics portion of the terminal display to be “dumped” directly into the printer by either depressing a special function key, or when a coded signal is received by the terminal.

The printer interface will also support non-graphics printers. As such, the Alpha mode will operate as described, but no Graphics “dump” will occur. To attach the light-pen and/or the printer interface to a Retro-Graphics-enhanced DEC VT-100 terminal, a connector assembly is required. Since the connector assembly replaces the VT-100 terminal back-shell, which may contain DEC’s current-loop option, an assembly can be ordered that contains an equivalent current loop.

The light-pen, Model VT20-LPN, is priced at $360. The printer interface, Model VT5X-PI Series, which consists of a six-foot cable and ROMs, is priced at $140. The connector assembly, Model VT1X-CA Series, without current loop is $135, and with current loop is $185.

by Digital Engineering Staff

Digital Engineering, Inc. 630 Bercut Dr., Sacramento, CA 95814. Circle 198
New Products

GRAPHICS VIDEO GENERATOR
Three Selectable Resolution Options
The VMD-05 for the LSI-11, 11/2 and 11/23 has resolution options of one or two channels of 256 x 256 or 512 x 256, or one channel of 512 x 512. Output is a composite video for either U.S. (60Hz) or European (50Hz) TV sync. Each channel has two outputs, allowing the dual channel version to drive up to 4 video displays or hardcopy devices. Provides a full graphics display capability, with each display stored in onboard MOS RAM and each point independently addressable. The PICPAC software package for RT-11 and RSX-11 operation systems provides a full set of routines for both characters and graphics. The VMD-05 is $1495 (1-4). Mennen Medical, 10123 Main St, Clarence, NY 14031. Circle 138

DEVELOPMENT SYSTEM AND EMULATOR
Provides Universal Multi-Processor, Multi-Vendor Support
The 9520, designed to be expanded to a two-user system, provides high-level languages and a total µP software development system in a single enclosure. It has 64K of memory (all memory includes parity), 4 serial ports (3 RS 232, one RS 422) and an IEEE 488 parallel port. It is also provided with 2 dual-density floppy disk drives for total working storage of 1MB. DMA access is provided for overlapped processor and disk activity. Operating under MPM, the 9520 uses a screen-oriented text editor to speed program preparation and changes, and can perform two or more functions simultaneously. The basic 9520 software development system is $7,495. The 9508 is a free-standing hardware debug station, providing the user with an efficient means for developing hardware, debugging software and integrating hardware and software into a working system. It provides full-speed emulation of the same 8-bit µP served by the 9520. The 9508 is provided with high-speed 16K static RAM (8K standard, 8K optional) emulation memory which is mappable into target system memory spaces on 1K boundaries. Emulation memory can be mapped anywhere in the address space of the µP being developed. The 9508 is $4995. Millennium Systems Inc, 19050 Pruneridge Ave, Cupertino, CA 95014. Circle 171

COLOR ALPHANUMERIC TERMINAL
Performance of an Intelligent Terminal with Advantages of Color Display
The CTM-300 is a serial RS-232C ASCII terminal with an 8 color CRT display. Its firmware executes intelligent commands and conforms to ANSI x 3.64 standard. Users may customize terminal functions from the host through program downloading into the 2K RAM for execution by the Z-80A CPU. Features include an array of editing features, Centronics printer and light-pen interfaces, a 256 character set including U&L case, graphics, control and European characters, 18 user definable function keys and a numeric keypad. The color monitor (optional), the detachable keyboard and CRT display stand allow operator flexibility. Speeds up to 19.2 K Baud can be user set. The CTM-300 is $2940 for a complete terminal including monitor. Matrox Electronic Systems, 5800 Andover Ave, Montreal, Quebec H4T 1H4. Circle 168

LOW COST µC NETWORK
Offers Power And Versatility of Mainframe Networks
OMNINET is an efficient one megabaud network that allows interconnection of up to 64 microcomputers and peripherals in a 4,000' serial link. The intelligence is centered around the OMNINET transporter consisting of a Motorola 6801 µP, a custom gate array, and associated support components. The transporter interfaces directly to the microcomputer or peripheral. No software intervention required. Initial product release is available for the Apple II, Oony C8000 and the LSI-11. It also connects to any Corvus 5, 10 and 20MB Winchechers, the Mirror or the Constellation. Future transporters will include the Apple III, Tandy TRS-80, any S-100 Bus computer and others. Plans are to provide gateways to Ethernet, SNA and other available networking in 1982. From $495 to $750. Corvus Systems Inc, 2029 O'Toole Ave, San Jose, CA 95131. Circle 140

LONG LIFE BATTERY
Up to Ten-Year Service
This cell provides rechargeable standby power for volatile memory devices in micro-electronic systems. The 1.2 V battery operates from -40° to +85°C, and discharges at a rate of less than 1%/day at 25°C. Available in a standard 1/2 AA size, weighs 5.9 grams, and is available individually tabbed and in special configurations. Also available is a line of lithium manganese dioxide (LiMnO2) batteries which are wave-solderable and polarity-keyed for efficient installation. These PC board-mountable batteries are available in capacities of 160, 170, 200 and 1000 mAh. The line also includes 15 sizes of button and cylindrical shaped cells. The LiMnO2 batteries provide shelf life up to 10 years at 23°C, flat voltage profiles and operation from -20° to +50°C in CMOS RAM backup. General Electric Co, Batteries Business Dept, Box 861, Gainesville, FL 32602. Circle 130

RMOX CONTROLLER
Disk System Solution for PDP-11
This low-cost disk system based on a single-board controller emulates the PDP-11 RMO2/03/05 controller including RMOX media compatibility, and is software transparent to all standard DEC operating systems. The RMOX/6100 has a high speed bipolar µP design and operates with a variety of industry standard Storage Module Drives. It uses the AMD Z8068 burst error processor (BEP) to examine on a read operation the data and 32-bit ECC field. The BEP detects all errors and permits an 11-bit error correction. It includes a 4-sector static RAM data buffer (2048 bytes) to compensate for the speed differences between the disk and the computer interface, thus eliminating data late conditions. The RMOX/6100 supports dual port drives as well as contiguous sector data transfers — up to 64k words for a single drive command. In multiple units, a 160MB Winchester system with the RMOX/6100 controller is under $10,000. System Industries, 525 Oakmead Pkwy, Sunnyvale, CA 94086. Circle 147
5½" FLOPPY DRIVE

Breaks 2 MB Barrier

The Megafloppy 1117 family includes two single and two double sided drives using 96 or 100 tpi double track recording technologies. Increased storage capacity was achieved by increasing data recording density from 6,000 bpi to 12,000 bpi using MFM recording techniques. Model 1117 provides 6 ms track-to-track positioning speed with 600,000 bps data transfer rates, and also provides full compatibility with industry standard interfaces. Double sided models provide 2.175 and 2.025 MB of formatted storage at 100 and 96 tpi respectively; single sided versions offer 1.2 and 1.1125 MB. Volume deliveries in January 1982, limited quantities available earlier for system integration and evaluation. Micropolis Corp, 21329 Nordhoff St, Chatsworth, CA 91311. Circle 169

OEM DEVELOPMENT SYSTEM

To Familiarize OEMs with Voice Data Input

This speech recognition system is a stand-alone OEM development system with vocabularies up to 128 words or phrases. It allows the manufacturer of computer-based systems to experiment with user-trainable voice recognition. A custom design and manufacturing service is also available. The 9000 consists of a CRT terminal, a voice processor, a floppy disk drive to store vocabularies, a noise-cancelling microphone, plus complete documentation. The system is completely self-contained, no host programming is required. All system commands can be generated by voice, allowing complete hands-free operation. The 9000 Series is from $3525 to $4995. Heuristics, 1285 Hammerwood Ave, Sunnyvale, CA 94086. Circle 132

ECLIPSE ADD-IN MEMORY

Contains On-Board ECC

The MK8018 for DG's Nova 4S and 4× processors, is also compatible with the Eclipse S-140. It contains ECC on the memory board and has an on-board maintenance feature which allows a user to trace a MOS component failure to a specific RAM using an on-board LED. The 128 kB version is $3780, the 256 kB board is $5700. Mostek Corp, 1215 W. Crosby Rd, Carrollton, TX 75006. Circle 142

µP-BASED DEVELOPMENT SYSTEM

High Level Language Support

The system is targeted to meet the requirements of microcomputer system designers using high level languages and requiring the support of future 16-bit µP's. It employs two Z80A µP's in a master/slave configuration. The master processor has access to 64 kB of RAM and controls the operating system. The slave processor, which controls user programs, also has its own 64 kB RAM. A spooled printer allows printing and simultaneous editing, compiling, assembling or performing any other development system work. A programmed-function keyboard offers 8 upper-and 8 lower-case function keys which may be programmed to provide access to a total of 16 functions. A system resident debugger does not occupy any user space in memory. FORTRAN and BASIC can be used on STARPLEX II with optional high level language support of PL/M and Pascal. Code generators for 8080/8085 and Z80/NSC800 8-bit processors are available as well as CP/M interface. The STARPLEX II, SPX-90/51 is $15,950 for a standard configuration. National Semiconductor, 2900 Semiconductor Dr, Santa Clara, CA 95051. Circle 187

The UGLY Switchers

Their reliability makes them beautiful!

Elpacs has over a million power supplies in the field, with a beautiful record of 1% return rate for any reason. That's reliability!

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Santa Ana, CA 92705
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Wescon Booth No. 910
Circle 37 on Reader Inquiry Card

AUGUST 1981 Digital Design 103
New Products

POWER CONDITIONERS
For Plug-In Compatibility

These single-phase conditioners have a choice of 5 Output Receptacle Panels to provide users of 5 kVA to 10 kVA Line 2 Power Conditioners with plug-in compatibility to most computer systems. They protect against 99.5% of all power line disturbances. Each Output Receptacle Panel has between 7 and 11 output receptacles that distribute power to an equal number of equipment loads. Circuit breakers provide overload protection to all receptacles which are rated at either 120V, 240V or 120/240V. From $2360 for a Power Conditioner with an Output Receptacle Panel and from $2060 for a standard terminal block configuration.

PERIPHERAL PROCESSOR
Provides 38.4MB of On-Line Storage for Q-Bus Based Systems

The 537 consists of a quad width board that supports a mix of two Cii Honeywell Bull (Cynthia) D120, two D140 disk drives or one D120 and one D140. The board can be plugged into any Q-Bus SPC slot. It utilizes a 16-bit 2901 bi-polar bit slice μP to provide operating and diagnostic commands. This dedicated approach eliminates the necessity of custom configuration required by disk subsystems with multiple drive type options. Installation time is reduced and system availability is increased. Xylogics Inc., 42 Third Ave., Burlington, MA 01803. Circle 149

UNIVERSAL PERIPHERAL
For Bit-Slice/Bipolar Test and Debug on Any System

Over the CCI’s serial links, a target processor’s programs can be automatically loaded, and the processor’s operation monitored, and controlled. The system is easily customized to a particular architecture and instruction set. The CCI contains reconfigurable (8 to 96 bits or greater) high speed (to 36ns) memory to hold the target processor program; high speed logic analyzer, 32 or 80 bits wide, with sequential triggering, multiple trigger equations and 5 trigger sources to enable real time monitoring of the target processor; control circuitry to half target processor execution in real time, run multi-step, multicyle, execute single instruction and R/W registers; and dual independent RS232 ports with programmable baud rate (110-9600), stops bits, parity, echo, line protocol and function. A full set of high level control commands and status queries simplify the task of writing CCI routines. From $6,950 to $40,000. Step Engineering, 757 Pastoria Ave, Sunnyvale, CA 94088. Circle 175

DATA CAPTURE PROGRAM
Digitize Directly From a Free-Hand Electronic Sketch

The NON-Gridded Electronic Schematic Data Capture Program, DS1, is available for DEC’s VAX 11/780, and the SCI-Cards interface for SCI users. DS1 allows the computer operator to digitize directly from a free-hand electronic sketch to computer. A typical “D” size drawing takes 1 hour max to digitize. The computer automatically straightens the crooked lines, inputs the correct size symbols, as well as entering imposed alignments among the symbols. With the Non-Gridded concept, the operator simply scribbles in the changes on the drawing, performs the edit in minutes and outputs the final drawing. It is also operational on the DG Nova 4X and Eclipse, Univac, IBM and Harris Computers. Design Aids Inc. 27822 El Lazo Road, Laguna Niguel, CA 92677. Circle 133

CDC-COMPATIBLE DISKS
Phoenix-Type Cartridge and 300MB Disk Pack

The 681 is a 16MB Phoenix disk cartridge compatible with Control Data Corporation’s Model 9448 disk drive or equivalents. It contains one 75-mil platter with one servo surface and one formatted surface. Storage density is 384 tpi and 6,038 bpi. $275. The 1263 is a 12-high, 300MB storage module compatible with CDC’s 9766 or equivalent drives. It has 10 recording disks, 19 recording surfaces, plus top and bottom protective disks. A servo surface is prerecorded to provide precise control data for seeking, position sensing, and clocking. Track density is 384 tpi; bit density is 6,038 bpi. $1,100. BASF Systems Corp, Crosby Drive, Bedford, MA 01730. Circle 137
DZ11 COMPATIBLE MULTIPLEXORS
For LSI-11 Q-Bus Systems

These Unibus software compatible DZ11 multiplexors enable a user to employ an LSI-11/23 processor in a communications environment generally requiring a PDP-11/34. The MLSI-DZ11 series includes units which provide all of the features of the

Unibus DZ11-A/DZ11-B (EIA) 8-line multiplexors and the DZ11-E (EIA) 16-line unit. Another model combines the characteristics of the DZ11-A and the DZ11-C (EIA and 20 mA current loop). They offer programmable character formats and data rates from 50 to 19.2K baud. The MLSI multiplexor modules contain a 64 character buffer with a 16-bit SILO counter which allows minimal processor intervention.

From $1350 to $2800. MDB Systems Inc, 1995 N. Batavia St, Orange, CA 92665.

Circle 135

PASCAL COMPILER SYSTEMS
Ensures µP Software Portability

This series of compiler-based software development systems is designed to speed both the development of Pascal programs and their movement from one µP to the next. The PAS-86 series includes compilers for 8-bit and 16-bit applications, plus an optional 8-bit interpreter package to support 8080 and 8085 µP applications. The first packages run on VAX and PDP computers and on IBM System 370 computers as hosts.

They support development maintenance and upgrading of programs for Intel's 8086/8087/8088 µP family. Additional packages for other hosts and target µPs will also be available. Language Resources Inc, 4885 Riverbend Rd, Boulder, CO 80301.

Circle 134

PDP-11 READER-PUNCH
Off-Line Keypunch Capability Included

For PDP-11 and LSI-11 computers, Model RP8211 can read 80 column punched cards at 200 cards/minute and punch (with printing) at 45 to 75 cards/minute. It can also be used as a freestanding 80 column key punch, verifier, reproducer and interpreter. Editing of a selected column is possible thru punch suppressing and print editing features. For batch applications, it is a complete data entry unit when documents are transcribed and verified. The RP8211 is $8,500. Qty. discounts as well as lease and maintenance rates available. Cardamation Co, Box 746, Frazer, PA 19355.

Circle 127

Unibus repeater for PDP11 series systems.

Do you need to add peripherals or additional cable lengths to an overloaded bus? Do you have unknown system crashes such as caused by a type 4 trap — delayed response from a slave sync? Is your current repeater too slow for your current system?

If these questions are relevant, then Datafusion Corporation has a device that can answer your needs, the OSB11-A Bus Repeater. It is a functional equivalent of DEC's DB11-A, and is designed to drive at least 19 bus loads and 50 foot of bus cables.

Ultra Fast: 80 nanoseconds MSYNC to return SSYNC maximum (40 nsec one way). This is due, primarily, to the specially designed patented integrated circuit employed by the OSB11-A.

Reliable: Only 34 operational circuit components. Tested in environments from 0° to 70°C with virtually no degradation of signal quality.

Easy to Install: Remove a M920 Jumper and replace it with a OSB11-A. No extra system unit is needed; no wires or plugs to connect (or disconnect); no lost time in reconfiguration.

Available: Off-the-shelf. And, it's fully supported and warranted.

Cost: About 25% below DEC® Quantity discounts are available.

Other PDP11 products available are a Busrouter (a Unibus® Switch) to reconnect multiple peripherals to one or more PDP11 cpus, a Unibus® Cable Tester, and an Associative File Processor for high speed text search — a hardware approach.

We also have some ideas for the application of our products which might not have occurred to you. If you can't get the performance that you would like from your PDP11 system, maybe we can help. Please telephone our Marketing Manager at (213) 887-9523 or write to Datafusion Corporation, 5115 Douglas Fir Road, Calabasas, California 91302.

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Circle 38 on Reader Inquiry Card

AUGUST 1981 Digital Design 105
R/W RECORDER
Utilizes a Plug-In Bubble Memory Cassette
The BMR8 withstands harsh environmental conditions and delivers reliable data on a removable, non-volatile, solid state medium that may be reused without degradation of performance. Input and output of data may be via an RS232C mode or a 20 mA current loop or a parallel TTL 8-bit mode. Features recording speeds of up to 19,200 Baud or 2000 bps, capacity of each bubble cassette — 64,000 bits, error rate of 1 bit in 10⁶, memory that remains undisturbed when power is turned off or when the cassette is removed, and CMOS logic throughout. $1495.
Memodyne Corp, 220 Reservoir St, Needham Heights, MA 02194. Circle 193

DISTRIBUTED PROCESSING SYSTEM
Enhanced 2200 Series
With the 2200 Series integrated workstation, data processing, word processing and host communications can be performed at one terminal. Enhanced telecommunications protocols include emulation of the IBM 3274 Cluster providing access into both a bisync and SNA/SDLC environment. Support of X.25, X.21, enhanced 2780/3780 and Teletex enables users to communicate directly into SNA or X.25 networks while maintaining local system responsiveness and control. Programming tools include COBOL, and an enhanced version of Wang BASIC. The Remote Control and Maintenance System (RCMS) provides central control and monitoring of all remote 2200 systems. Wang Laboratories, 1 Industrial Ave, Lowell, MA 01851.

LSI-11 CONTROLLER
For Magnetic Tape Drives
The QCI connects any of Digi-Data’s 192 reel-to-reel tape drive models with self-contained formatters to a DEC LSI-11 via the Q-bus. It is compatible with LSI-11, 11/2 or 11/23 computer systems, emulating the TM-11 controller and compatible with RT-11/RSX-11. The QCI supports up to 2 tape formatters, each capable of handling 4 tape drives. Packaged on a single quad circuit board using 60% less power than comparable multiboard configurations. $1300 (qty. 100). Digi-Data Corp, 8580 Dorsey Run Rd, Jessup, MD 20794.

GRAPHICS OPTION
Tektronix Compatibility for VT-100
The 4010 emulation option to Selanar’s Graphics 100 allows VT-100 users to display high quality graphics data. The Graphics 100 feature will fit any VT-100
series CRT and does not require a CRT tube change. A light pen option reduces the need for keyboard interaction. Graphics 100 is $1200; Tektronix option is $250; light pen is $450. Selanar Corp., 2403 De La Cruz Blvd, Santa Clara, CA 95050. Circle 143

**SPEECH VOCALIZER**

*Converts Serial ASCII Data Into Speech*

This unit can be used as a stand-alone peripheral for paging, instructions, vocal reminders or any automatic speech output. It can also be added to an existing terminal to vocalize portions of the display such as error conditions, operator messages or prompts. Vocabulary can be up to 800 words. The VOCALIZER contains an internal amplifier, loudspeaker and an RS-232C communications interface that operates from 110 to 19,200 baud. The unit responds to commands to set output loudness levels and to flush the internal buffer for emergency messages. Custom vocabularies available. The basic unit is $1395. Micro Communications Inc, 1509 Government St, Suite 214, Mobile, AL 36604. Circle184

**ARRAY PROCESSOR**

*Transforms an LSI-11 Into a Fast Number Krunching System*

SKYMNK provides high-speed (up to one megaflop), floating point processing on two quad PCBs that plug into any LSI-11 or 11/23 quad Q-bus backplane. It operates under RT-11 or RSX-11M for FORTRAN or Macro programs, and can compute vector math, Fast Fourier Transforms, digital filtering, format conversions, and image processing at speeds 50 to 100 times faster than microcomputer stand-alone time. It shares the host's memory, up to 1 MB addressable. The SKYMNKN extends the LSI-11’s instruction set to include vector, matrix and compound mathematical instructions computed in real and complex arithmetic. $5990; OEM qty. under $4K. SKY Computers Inc, Box 8008, Lowell, MA 01852. Circle 146

**DEVELOPMENT/CONTROL SYSTEM**

*Based on the Intel 8086 16-Bit \( \mu P \)*

The system consists of dual 8" IBM compatible floppy disks, 9-slot Multibus card cage with integral fan and heavy duty power supply. The 8086 CPU card (DCS 86/16) is Multibus compatible and contains 3 serial ports, 2 of which are capable of high level bit protocols such as HDLC and SDLC. One of the protocol ports is RS-232 and the other is RS 422/423 for network communications. The CPU also contains 24bits of parallel I/O for printer interfaces, etc. The CPU has vectored interrupt, counter/timers, PROM/ RAM sockets and full multimaster capability in a multiprocessor environment. The DCS/86 is $6500 for a 64kB system with CPM/86 disk operating system. Also available is the ICM/80, a Multibus compatible chassis designed for 19" rack mounting or NEMA sealed enclosure. It contains a 9-slot Multibus card cage with integral fan assembly and can accommodate up to 4 signal conditioning I/O panels providing up to 64 opto-isolated channels for control applications. Distributed Computer Systems, 223 Crescent St, Waltham, MA 02154. Circle 128

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The Hecon with the Hopper.

The Hecon A0542 impact dot matrix ticket printer with hopper feed. Load up to 75 tickets in the easily accessible hopper. When you are ready to print, the A0542 automatically feeds, prints and transports the ticket for removal. You can even reinsert a ticket for additional printing thru the unique reprint feed slot.

The highly visible Time and Date feature is standard and can be printed with a single command.

The A0542 can print the 96 character ASCII set bidirectionally at 120 characters per second. The standard print head is rated at 200 Million characters minimum for long, dependable service.

It's got to be good. It's a Hecon.

Hecon Corporation, 31 Park Road, Tinton Falls, NJ 07724 • (201) 542-9200

Circle 49 on Reader Inquiry Card
INTERFACE EVALUATION PACKAGE

Attach Non-IBM Equipment to IBM Mainframes at a Lower Cost

By providing both hardware and software, the user can now interface almost any non-IBM device directly to the channel. The 8900 Programmable Channel Interface Module consists of 3 quad-width PCBs that appear as a single module to the LSI-11 Bus. It provides channel-speed communication between any IBM (or IBM plug-compatible) Selector, Byte MUX or Block MUX channel and the LSI-11 Bus. It can respond to any subset of the 256 possible sub-channel addresses. The 8010 Driver/Receiver Module is a single PCB that converts IBM channel signals to/from TTL levels for use by the 8900. Off-line and Select priority functions are incorporated. The ARIES Software Library provides high-speed data transfer in a variety of interface configurations. The Channel Interface evaluation package includes the 8900, 8010, ARIES source, all interconnection cables and switches and is $6995. Auscom Inc, 2007 Kramer Lane, Suite 102, Austin, TX 78758.

DISTRIBUTED PLOTTING SYSTEM

Reduces Plot Turnaround Time

A disk based system, PMS 7000 manages up to 8 Gerber pen plotters or photoplotters in a distributed plotting network. Plot queuing, data conversion, job accounting, and data transmission enable more efficient distribution of plotting resources. From a single command post PMS 7000 users collect and convert data, allocate workload, prioritize plotting requirements, transmit information to remote plotting systems, and control and monitor the entire plotting operation. The plot queuing feature assigns priorities for up to 32 plotting jobs and automatically transmits the data to the next appropriate plotter. Basic configuration includes two Interactive Video Display Stations with a shared ASCII keyboard, mini-computer (256K), 19.6 MB disk-drive, dual density magnetic tape unit and one plotter interface. Gerber Scientific Instrument Co, Box 305, Hartford, CT 06101.

UNIVERSAL DEVELOPMENT SYSTEM

For Bit-Slice or Fixed-Word-Length Processor Support

The EZ-PRO incorporates μP architecture and modular design to meet each user’s exact application requirements. In Bit-Slice Systems, the EZ-PRO supports all of the TTL and ECL bit-slice...
products. It can accommodate microprogram word lengths to 128 bits and depths to 2K words. With a shorter microprogram word, up to 8K words can be accommodated. Both ECL and TTL PROM Programmer Modules are available for programming or reading up to 8 PROMs at a time. From $11,335 to $26,800 including all required software, a video terminal and printer. In Fixed-Word-Length Systems, In-Circuit Emulators are available for the 2650, 6502, 6800, 6802, 6808, 6809, 8080, 8085 A/A-2/80 and the 3870 family. Programs supplied with each emulator include a Macroassembler, Linking Editor, Debugging Routine and Demonstration Program. $8485 with 32 kB of static memory, one In-Circuit Emulator, a printer, dual floppy disk unit, video terminal and operating software. American Automation, 14731 Franklin Ave, Tustin, CA 92680

The non-rotating MaxiRam is a solid-state disc replacement storage system that operates at the speed of main memory. It is ideal for the following: ...if your processor is disc I/O bound. ...if your CPU spends too much time in the 'wait' state. ...if your present disc gives you reliability headaches. Write or call to find out how your memory performance and reliability can be dramatically improved. Units available in both core and semiconductor.

Imperial Technology, Inc.
831 S. Douglas Street • El Segundo, California 90245 • Telephone: (213) 679-9501
Circle 40 on Reader Inquiry Card

It's tough to stay on top in our industry. Trade journals, third party dealings, and huge impersonal conferences aren't enough.

The Norm De Nardi Computer Shows give you the opportunity for hands-on demonstrations and personal dialogue direct with the manufacturer. All in one day, within minutes of your office.

In one afternoon you can see the latest in OEM and sophisticated end-user computer graphics, disc drives, microcomputers, terminals, printers and other peripheral products our industry has to offer. You'll have an opportunity to exchange ideas with such manufacturers as Tektronix, Ampex, CDC, Shugart, Centronics, IBM, Data General, DEC, Dataprocessors, Perkin-Elmer, Xerox, Versatec, Intersil, Hewlett-Packard.

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EEPROMs Aid POS Terminals

Remote reconfiguration capability can save millions of dollars in Point Of Sale (POS) Terminal service costs. With the capability of EEPROMs, remote changes in terminal constants are now possible; no service personnel are necessary. How often have product codes and pricing information needed changes? In today’s economy, one might answer “too frequently”. With service costs today of over $100 per hour, those changes can be very expensive. The EEPROM benefits users of POS Terminals by completely eliminating service costs.

POS Terminals typically use look-up tables to contain product descriptions and pricing information. These tables require several different characteristics to operate optimally in a POS environment. The first storage attribute is non-volatility; look-up table data must be held without power for many months or years. Second, a dense storage medium is required because typically many products with complex encoding schemes are loaded into the look-up tables. Finally, a medium that can be changed easily is needed because pricing and product information changes frequently. All of these necessary features have been satisfied in the past with EPROM memory or CMOS RAM with battery backup.

Unfortunately, these media have drawbacks. EPROMs, while low cost, dense and non-volatile, cannot be changed in the field without a service technician. CMOS and battery backup offer more flexibility at lower density, but can suffer reliability problems if the battery and backup system aren’t properly designed. The EEPROM offers users all the characteristics of EPROM with the flexible advantages of battery backed up RAMs. Look-up table data can be stored non-volatile, but can be changed while in system. Figure 1 shows the block diagram for such a system. The terminal is composed of a high-performance µC, such as the 8051. In addition, memory is used as data and as look-up table storage. The typical I/O device structure for a terminal also exists in the system as shown. The most important interface indicated on the block diagram is the serial I/O link. The datacom or telecom link provides the system with remote reconfiguration capability. The contents of the EEPROM, a 2816, can be changed from a central location, without need for costly human service.

The look-up table contains product description and pricing information. Once the table is written, the CPU can read from it as necessary to translate product entry codes to price information. If for some reason the table data needs to be changed for pricing or product updates, then the central computer simply sends update commands and new data to the remote POS processor. Since all remote terminals are linked together at a central location and are in periodic communication with each other, such an update can occur as a part of normal inter-processor communication.

The in-system erase capability of a 2816 memory allows the table data to be changed remotely, while preserving the stand alone nature of the terminals. Without EE capability, a service technician would be required to change the table data.

In addition to containing product description and pricing data, the EEPROM can store special data unique to a particular location. If a set of locations within the memory is set aside for reorder codes, then as a location runs short of a particular item, the computer can automatically restock it. If particular information is sensitive, the 2816 can store encryption codes and software lockout mechanisms.

Another capability gained from the use of EEPROM is that daily totals in sales volume and product quantities can be stored in it. This information can be accessed by the local users as well as by the central data bank.

In such EEPROM-based POS terminals, flexibility and greatly reduced service costs are the key. The EEPROM contains product information that can now be changed from a central location without the use of very costly service personnel. It yields an ideal solution to data table storage problems in frequently altered POS systems.

by John F. Rizzo
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