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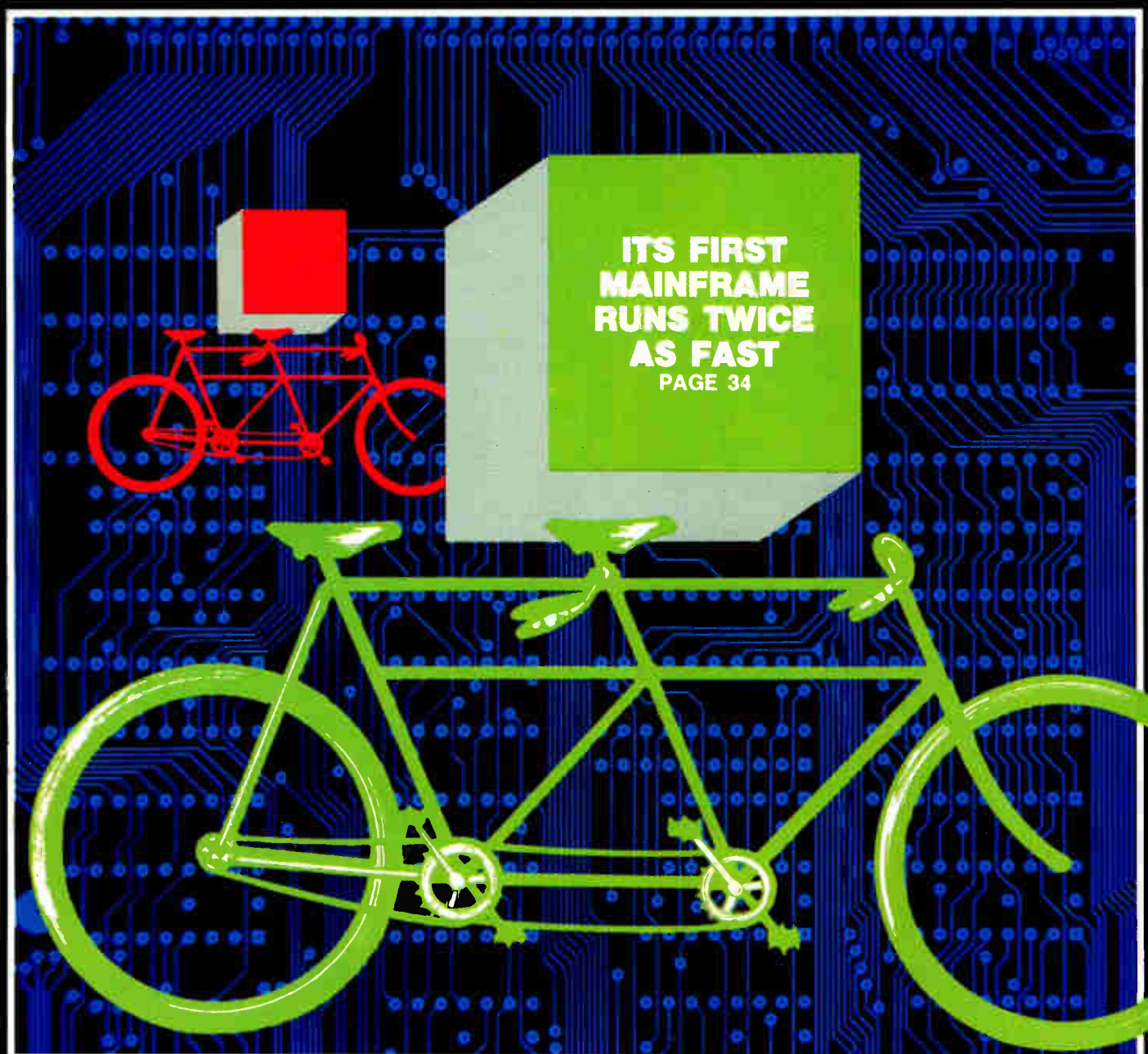
Electronics

THE WORLDWIDE TECHNOLOGY WEEKLY

APRIL 14, 1986

TANDEM MAKES A GOOD THING BETTER



'NICKEL AND DIME' GROWTH ADDS UP IN PC SOFTWARE/24

VECTOR PROCESSING GIVES HYPERCUBE CRAY SPEEDS/30

The only thing small about it is its size!

The RTP-650A is the only portable data recorder that gives you bigger performance than a reel-to-reel.

- **DC to 40kHz frequency response on 14 (or 21) channels** — at a 76.2cm/sec (30 ips) on Beta format video cassette tape. Covers twice the IRIG WBG1 bandwidth on any of the other six tape speeds. WBG1 is selectable for an even better SN ratio.
- **Superior vibration resistance (tested in conformity with MIL-STD-810C)** plus a compact and lightweight design give you a wholly new latitude of applications.
- **FM, DR and PCM recording — three modes in all** A first for a desktop data recorder.
- **Optionally available GP-IB port** lets you easily configure a computer-controlled data acquisition and processing system.

And it's easier to use than any other data recorder.....

- **Bright easy-to-read menu style EL display** provides the window for easy access to the multi-microprocessor intelligence.
- **Programmable settings for simpler operation** Even an unskilled operator can use it on site.

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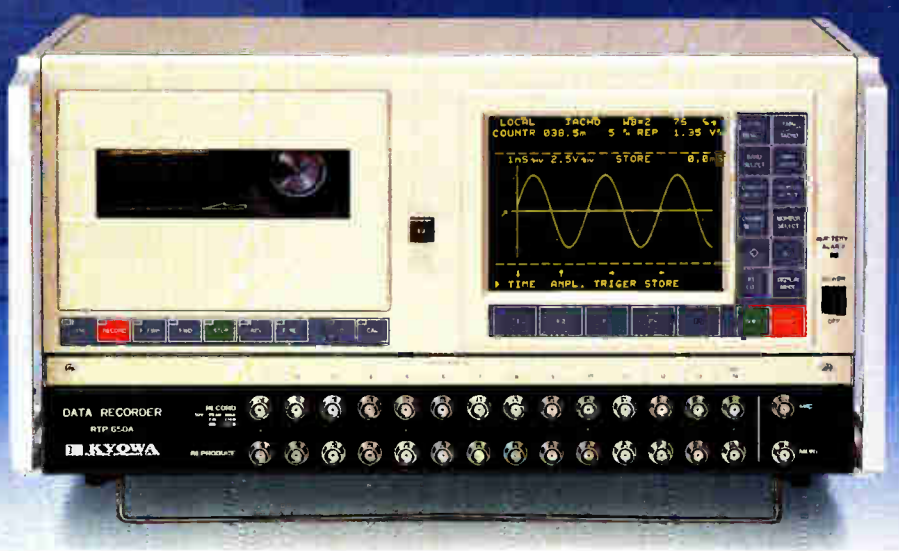


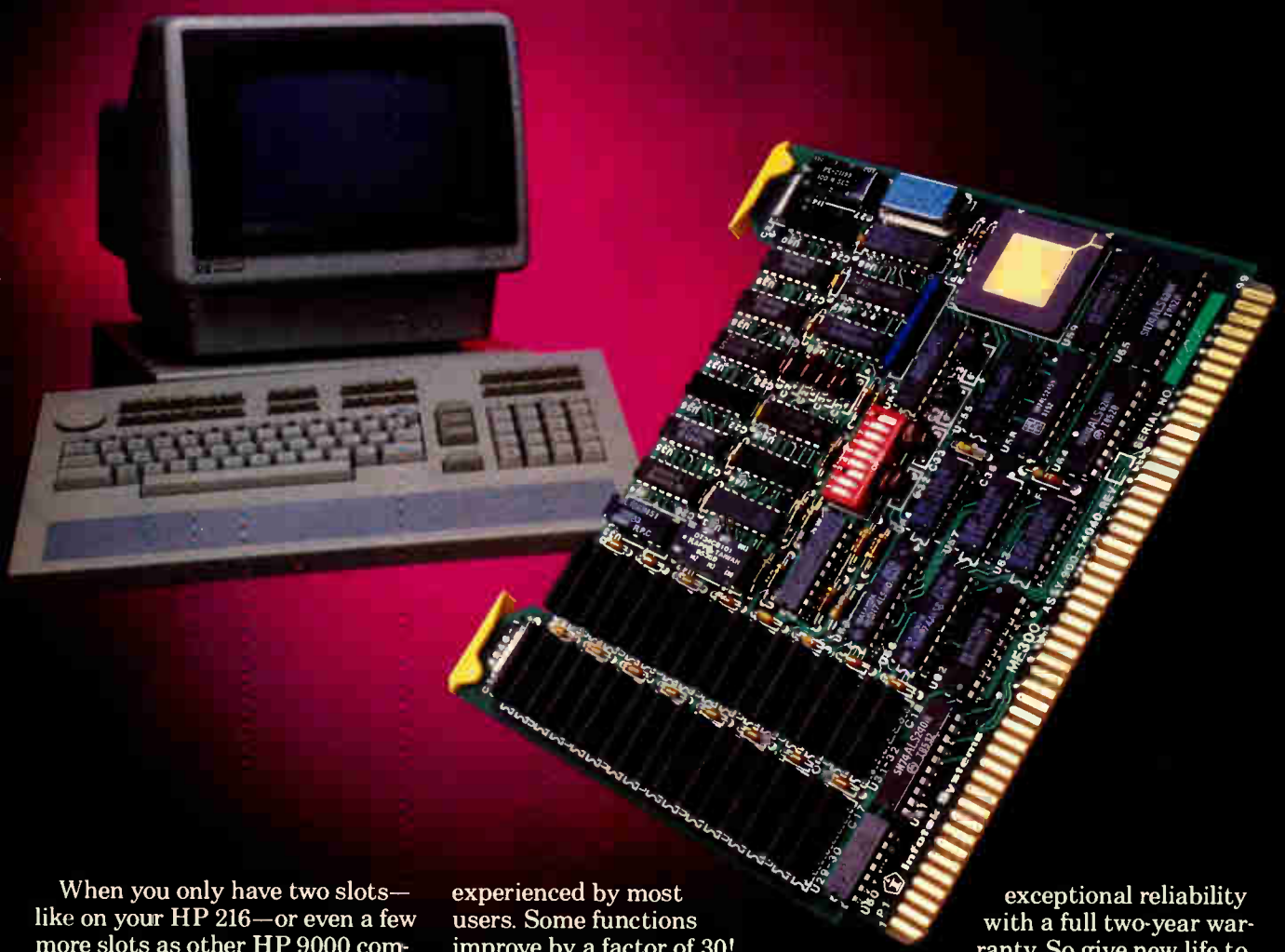
RTP-650A

VIDEO CASSETTE DATA RECORDER

Circle 900 on reader service card

TWO FUNCTIONS ONE CARD

1 MByte memory + 1 floating point processor on a single board for your HP Series 200/300 computer.



When you only have two slots—like on your HP 216—or even a few more slots as other HP 9000 computers do, you want the most capability in the least possible space. Now, you can have a full megabyte of memory plus an advanced floating point processor on a single card—the MF 300 from Infotek.

The MF 300 incorporates a powerful floating point processor (based on the Motorola 68881 processor) which significantly increases the speed of transcendental functions as well as arithmetic operations for both BASIC and Pascal. For math intensive applications such as CAD, improvements in speed of three to five times are experienced by most users. Some functions improve by a factor of 30!

The same performance (without the memory) is available in the new FP 881 floating point processor. Or you can choose the Infotek FP 210 floating point processor for BASIC and Pascal. The FP 210 employs the National 32081 processor to increase real arithmetic speed as well as transcendentals. And all floating point boards further enhance real math functions when used with Infotek's BASIC compilers.

As with all Infotek HP enhancement products, the floating point processors demonstrate their exceptional reliability with a full two-year warranty. So give new life to your HP 216 or other 9000 computer! Put maximum performance in a single slot. Call Infotek Systems at (800) 227-0218, in California (800) 523-1682, or (714) 956-9300, 1400 North Baxter Street, Anaheim, California 92806-1201, TELEX 182283.

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The race to deliver a true single chip 212A modem was won in November, 1985 when Silicon Systems released samples of its K212. The new SSI K212 is a full-featured, 1200 BPS modem in a single 28-pin DIP. It incorporates all the primary functions needed to construct a modem which exceeds Bell 212A performance requirements.

Included on the single chip are complete Bell 103 and 212A operating modes, a call progress monitor, and a DTMF dialer. The device also has an 8-bit parallel bus for the control of modem functions and will directly interface with the 8048/8051 family of low-cost micro-controllers. Its high functionality, low-power CMOS operation, and efficient packaging facilitate design usage and increase system reliability.

Simplifies Modem Design and Manufacturing

The one-chip K212 represents a new level of integration for modem IC's. It provides functions on a single chip which were previously only possible using many separate components. This new single-chip modem simplifies designs for users who are building intelligent modems, or who wish to incorporate datacommunications capability into specialized systems. A complete modem requires only the addition of the phone line interface and a control microprocessor. The K212 is ideal for use with any self-contained or integral modem system that incorporates a dedicated microprocessor for control and command interpretation.

Pricing and Availability

The Silicon System K212 one-chip modem is available from stock now. For prices or more product information, contact us today.

Silicon Systems, Telecom Products Division, 14351 Myford Road, Tustin, CA 92680 (714) 731-7110, Ext. 595.

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Circle 73 For Career Information

APRIL 14, 1986 VOLUME 59, NO. 15

Electronics

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Vector processing boosts Hypercube speed, 30
By adding vector processors to its iPSC parallel computer, Intel Corp. has boosted the speed by two orders of magnitude. The company claims the new iPSC-VX offers supercomputer performance at one tenth the price of an equivalent Cray

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With software on the way and networking companies showing interest, new capital gives the interactive technique a big boost

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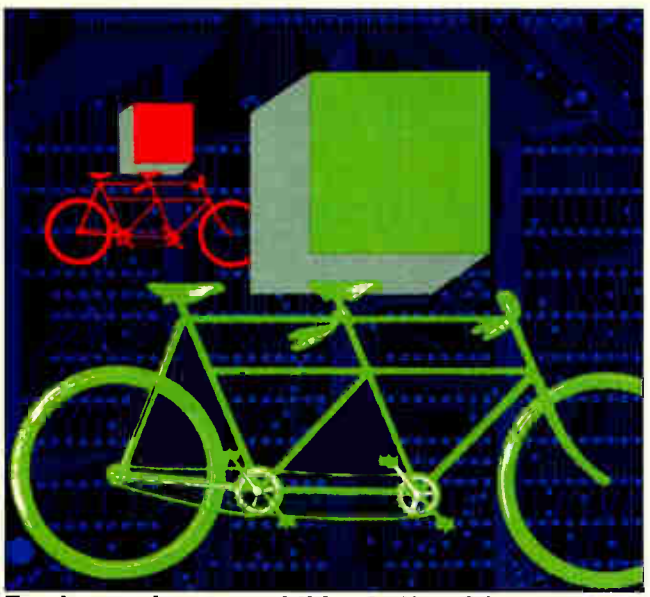
COVER



Tandem makes a good thing better, 34
Using an ECL gate array as a basic building block in its mainframe-class transaction processor, the NonStop VLX, Tandem Computers Inc. lopped 30% from the per-transaction cost of its supermini predecessor and tripled reliability

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Cover illustration by art director Fred Sklenar

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LETTERS

More 'mundane' data

To the editor: It was refreshing to see "mundane matters" like alpha-particle immunity in your recent issue [*Electronics*, Feb. 17, 1986, p. 15]. I'm sure many readers are interested in seeing more than access times and power dissipation in articles about chips.

May I suggest you include other boring stuff like reliability, availability, and serviceability characteristics of the devices you feature. Things like error detection and fault isolation, error-correction coding, redundancy, data integrity, etc. And also the chip real estate dedicated to these features.

I look forward to your insights each week but suggest that we readers wish to know more of the mundane chip characteristics. You've told us how fast they run and how hard they work. But what happens when they get sick? Do they ask for help...lie there and die...or get up and finish the race?

Mark L. Hill
Service Planning Representative
IBM Corp.
Burlington, Vt.

Sizing it up

To the editor: The special report "Inside Technology: Self-Testing ICs Begin to Emerge—Tentatively" [*Electronics*, Feb. 24, 1986, p. 33] incorrectly stated the size of Control Data Corp.'s CMOS gate array as 6,000 gates, including the On-Chip Maintenance System (OCMS) circuits.

The size of this device is actually 5,930 user-configurable gates, plus the OCMS circuits (approximately 2,500 gates) and input/output buffers (154 buffers), for a total equivalent gate count of approximately 8,500 gates. This 2-μm CMOS gate array is available under various product names from Motorola, National Semiconductor, and VTC.

Robert J. Humphrey
Marketing Manager
Electronic Design Automation Systems
Control Data Corp.
Minneapolis

Stable self-tuning filter

Correction: *In "Filter tunes itself automatically" [*Electronics, *March 17, 1986, p. 21], which describes the MOSFET-C filter developed at Columbia University in New York by a group led by Yannis Tsividis, the value given for the amplitude stability of the experimental chip was incorrect. The correct figure is 0.04 dB.*

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Tandem is a company that's "proving to be as rugged, and maybe even as resistant to failure, as its fault-tolerant computers," says Jonah McLeod about Tandem Computers Inc. "It has managed to prosper in a business that is getting tougher by the day."

McLeod, our test and measurement editor in Palo Alto, is the author of this week's cover story (p. 34) on the first Tandem machine that can be considered a mainframe, the NonStop VLX. Completing the Tandem coverage package, the company and its strategy are explored by Palo Alto bureau manager Cliff Barney in a Probing the News that begins on p. 39, following Jonah's piece.

JONAH McLEOD: Finds an impressively rugged company.

Jonah says that the ironic thing about Tandem's ruggedness is that it may be absorbed unintentionally from Tandem's archrival in the fault-tolerant computer business, IBM. For example, both lead designers on the VLX system worked for IBM before going to Tandem. Al McBride, technology director at Tandem, was responsible for the new system's macrocell arrays, and John Beirne, engineering manager, was in charge of the hardware work. Actually, the way things are set up at Tandem, McBride's title puts him one managerial level above Beirne.

But the corporate culture of the company tends to make such distinctions irrelevant, according to Jonah. The way Beirne explains it, even though McBride is technically in a higher position, "technology people are a resource shared by everybody in the company. It's just like at IBM, where the technology guys are out there helping the systems people solve the problems."

Editing material in New York gathered from around the world is a task that often requires the skill of a surgeon. But sometimes the scalpel slips, and you can be sure that the editors hear about it—often in the form of a deft jab that cuts neatly and quickly.

That's what happened last week when Charlie Cohen, in Tokyo, discovered an editing gaffe in one of his stories before it was printed. Charlie's reminder about the subtleties of the language is a classic of the genre:

"Did you ever hear Harrison Salisbury's story of how he wrote a dispatch from Moscow [when he was the *New York Times*'s correspondent] stating that he stood on the reviewing stand a stone's throw from Stalin? Evidently, the censor didn't understand the idiom and after receiving an explanation changed the text to read as follows:

" 'I stood on the reviewing stand close to Stalin. I threw no stones.' "

You might call the whole incident a bull's-eye for Charlie.

Laurence Altman

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SEIKO INSTRUMENTS

TECHNOLOGY NEWSLETTER

SONY PLAYS HIGH-DEFINITION MOVIES OFF VIDEO DISKS...

By using an elaborate digital processing scheme, Sony Corp. has come up with the world's first video disk and video-disk player for high-definition motion pictures (Victor Company of Japan earlier developed disks for high-definition stills). The Sony disk and player reproduce a high-definition TV signal with a full 20-MHz luminance signal together with 16-bit digital stereo sound. Two adjacent tracks are required for recording each frame on the optical disk because signal bandwidth exceeds that which can be recorded in single track. The digitally processed signal is converted to half of the original frequency, and alternate periods of the signal are recorded on adjacent disk tracks of the master by two laser beams. During playback, the process is reversed to obtain the original frequency. The two-track scheme cuts playing time to 10 minutes for constant angular velocity or 16 minutes for constant linear velocity—compared with 30 minutes and about one hour, respectively, for commercial laser video disks. In the CAV mode, still, slow, and fast playback are possible. Sony will show the gear at this week's National Association of Broadcasters Convention in Dallas. □

...AND SHOWS THEM ON A $45,000 MONITOR

Sony also showed up at the NAB Convention with a high-definition color monitor using the 41-in. tube that it announced a week earlier [*Electronics*, April 7, 1985, p. 9]. The resolution of the screen is more than 1,000 TV lines horizontally and more than 750 TV lines vertically, high enough for images of color-slide quality, claims the Tokyo firm. Sony plans to start sales in Japan in March 1987, at an estimated price of $44,444.44. □

FOUND: A WAY TO CUT CRT BULK WITHOUT SACRIFICING SCREEN SIZE

Alone Silicon Valley inventor may have come up with the solution to a problem that some large corporations have been working on for years—a way to cut down the bulk of a cathode-ray tube without sacrificing screen size. Samuel A. Schwartz of Saratoga, Calif., turned the trick with a design that deflects the electron beam horizontally, bends it, and then deflects it a second time vertically. He has built a 6-in. prototype of the short CRT and expects to have a 10-in. unit ready to show off at the Society for Information Display symposium in San Diego early next month. The 10-in. screen will be evaluated for marketing potential by a local company that cannot yet be named. Schwartz says his short CRT will cost 15% more than a conventional CRT, but much lower than a liquid-crystal display. His CRT is not a flat tube, like the one developed by Sony Corp. [*ElectronicsWeek*, Sept. 17, 1984, p. 18], but is one third to one half the depth of a conventional CRT and could have a screen as large as 25 in. Schwartz is now looking for backing to develop a color tube. □

ASIC LAYOUT TOOL DOES FLOORS

More help is on the way for designers of application-specific integrated circuits. Before midyear, SDA Systems Inc. of Santa Clara, Calif., will add a floor-planning tool to its kit of automatic placement and routing software. Using the new intelligent tool, designers can optimize layout of irregularly shaped macrocells to best suit timing and area constraints on the design. For example, if the design has a large block—programmed logic array, random-access memory, and the like—on a critical path on the chip in the horizontal direction and not in the vertical direction, the designer can change the shape of the block from long and thin, say, to short and flat to fit the horizontal orientation. □

MOTOROLA

Launch this dream.

Double performance in one fast move with the low-cost, MC34080 JFET op amp family.

Rise and shine, adjust your attitude, hold on to your hat. We have liftoff on an innovative new standard in low-cost JFET op amps that will change the way you work, think and design.

Because this practical, no-compromise, 8 MHz family doubles performance directly, immediately, on a pin-for-pin, socket-for-socket replacement basis over older, popular types. Without redesign, rework or rethink.

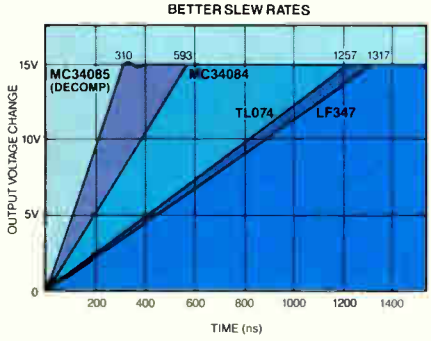
With a unique, all-NPN output stage, the MC34080 series is not only twice as fast as PNP-output also-rans, it also provides a benchmark in output voltage swing.

Start with a 25 V/μsec slew rate.

The compensated MC34084 quad slews 15 volts in less than 600 ns.

More than twice as fast as the TL074, it typifies the kind of gain bandwidth product and slew rate you need for high-speed applications.

Take active filters where most bandwidth-limited op amps fail miserably. Higher MC34080 family slew rate and bandwidth means what you get in your final design is really what you designed for--accuracy and efficiency. Put it on a scope trace with any other JFET quad in its category and you'll get comparative dynamics like this:

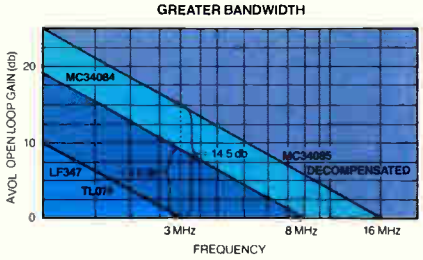


The decompensated MC34085 quad is four times faster than others. Two complete families of compensated and decompensated JFET op amps are available with the singles and duals offering the same 2-to-1 (for compensated) or 4-to-1 (for decompensated) advantage in speed and bandwidth.

What's more, they require only 2.5 mA drain current per amplifier...a significant, no-compromise spec since run-of-the-mill types with less than half the speed require nearly equal current.

More gain, no pain.

In a comprehensive, open-loop Bode-plot analysis, the MC34080 series demonstrates more than twice the gain and bandwidth of competitive LF- and TL- types.



This means your closed loop performance is closer to ideal. Plus, the all-NPN output gives you symmetrical gain and phase margins while sourcing or sinking current into capacitive loads--a nightmare for others.

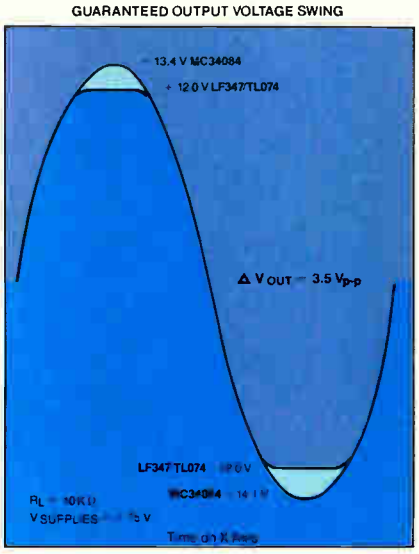
Now, your system stability is no longer a function of the output voltage swing.

Used in control systems, the MC34080 family follows, tracks and responds to higher-frequency signals quickly, accurately and honestly.

Highest guaranteed output swing.

This advanced family provides minimum guaranteed peak-to-peak output swing into a 2 K load that's 33% greater than others at room temperature. Spec'd minimum V_{out} of the MC34084 is 3.5 V_{p-p} more than that of the LF347 or TL074.

The new-generation, all-NPN output stage also furnishes low open loop output impedance at higher frequencies for improved system performance. Internal trimming cuts input offset voltage to within 0.5 mV maximum for the single and 1 mV for the dual.



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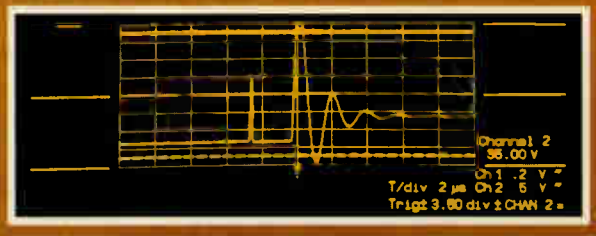

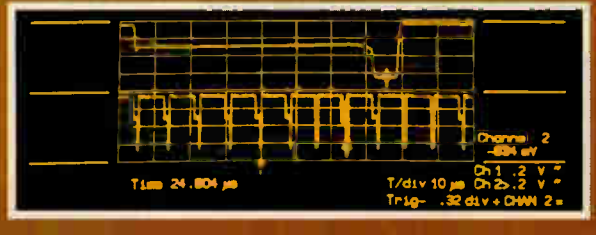

Top: Acquisition Parameters listing enables the 9400 user to precisely set and check front panel settings, all of which can be remotely controlled.

Middle: Window mode trigger set at ± 3.5 divs from center grid captures switching transient. 50% pre-trigger shows contact bounce prior to trigger moment.

Below: Crosshair marker, acting as a precise timer and DVM, gives time from trigger (arrow) and absolute voltage.

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Circle 12 for Demonstration

ELECTRONICS NEWSLETTER

AEROSPACE FIRMS TOLD TO DO AWAY WITH KICKBACKS...OR ELSE

Aerospace contractors have been warned to tighten their ethical codes and do away with kickbacks by subcontractors. The admonition came last week at a special meeting called by the Aerospace Industries Association in Los Angeles. The 600-odd defense-contractor executives who showed up heard about the Anti-Kickback Enforcement Act of 1986, a bill introduced early this year in the Senate. The legislation would, for the first time, make companies liable for civil and criminal penalties if their management of subcontracts is lax or negligent on corrupt practices. Maj. Gen. Bernard L. Weiss, commander of the Air Force contract-management division, warned that "normal commercial practices are no longer acceptable." □

WILL VAXMATE CAP DEC'S CURRENT SPATE OF PRODUCT ANNOUNCEMENTS?

Computer-industry watchers are now convinced that Digital Equipment Corp. will launch its long-awaited MS-DOS/VMS-compatible personal computer this spring. "All that's left is the VAXmate," says Marc Schulman, an analyst with Salomon Brothers Inc. in New York, sizing up DEC's recent spate of product announcements. Last week's unveiling of a refrigerator-sized VAX 8500 simply fills a hole in the Maynard, Mass., company's product line. The new machine can run at better than 3 million instructions/s—twice the performance of the popular VAX-11/785, but at about the same price: $260,000 for the basic 8500 with 20 megabytes of memory. □

NOW A SECOND-SOURCE DEAL FOR BIPOLAR ARRAYS THAT'S 'GOING TO WORK'

Bipolar gate-array customers have heard plenty of hoopla in recent years over what seems to be an endless stream of second-source pacts, but now Fairchild Semiconductor Corp. and Honeywell Inc. have inked one they say will deliver on its promises early next year. To be announced later this week, the pact calls for the exchange of technical information on emitter-coupled-logic and current-mode-logic gate arrays. Fairchild will start the second source by producing Honeywell's new HE8000 1.25-μm CML-ECL array, which has 8,000 equivalent gates. Honeywell will start with Fairchild's FGE2500 1.5-μm ECL arrays, featuring 2,500 gates. Orders will be accepted in the fourth quarter, and production will start early next year. □

GENE AMDAHL'S NEW ROLE: DEALMAKER BETWEEN U.S. AND JAPANESE FIRMS

Next month, U. S. companies will have a new entrée into the Japanese high-technology market when AIT Corp. goes into action. Started in Tokyo by Gene M. Amdahl, AIT will help set up cooperative deals—including development of new products—between U. S. and Japanese companies. AIT will earn its income from commissions on sales. Equity in AIT is split evenly among Amdahl—chairman of Trilogy Ltd., Cupertino, Calif.—three other U. S. investors, and three Japanese investors. □

WILL TAPE-DRIVE MAKERS HAVE TO PAY TO USE CIPHER'S LOADING TECHNIQUE?

Attorneys for the two leading manufacturers of ¼-in. tape-cartridge drives are pondering a tough question: whether the companies have to pay to use a cartridge-loading technique for which Cipher Data Products Inc., San Diego, was recently granted a patent. Cipher has offered nonexclusive licenses to Archive Corp., Costa Mesa, Calif., and Wangtek Inc., Simi Valley, Calif., and says it is reviewing tape drives produced by others for a similar deal. The patent covers Cipher's method of loading the industry-standard ¼-in. tape cartridge into drives having the 5¼-in. form factor. □

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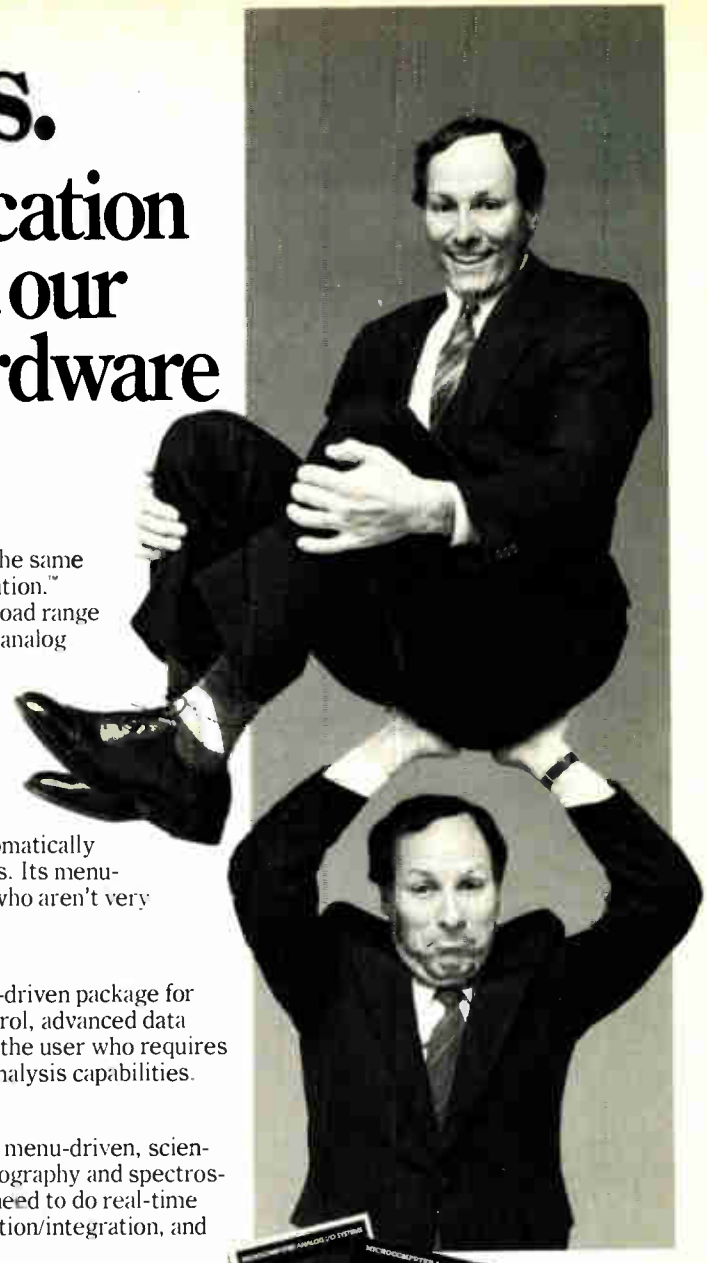

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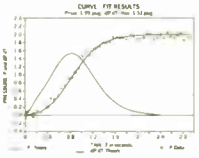

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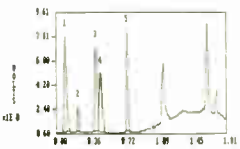

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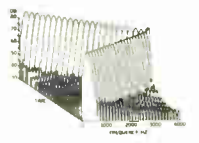

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Circle 14 on reader service card

PRODUCTS NEWSLETTER

CRYSTAL WILL LAUNCH ITS SMART ANALOG CHIPS IN TWO MONTHS

Crystal Semiconductor Corp. will introduce the first products using its Smart Analog technology within two months. The technology combines digitally controllable circuitry with analog circuitry on one chip [*Electronics*, Jan. 20, 1986, p. 21]. First products will include a T1 transceiver and a point-to-point interface link. Also close is a local-network IC. The Austin, Texas, company will fabricate the products in its new 3-μm CMOS facility. To fine tune the line, the firm is producing a dual-tone multifrequency receiver, which is not a Smart Analog chip. The CSC8870B chip is pin-compatible with the industry-standard Mitel MT8870B and will cost $4.50 each in lots of 1,000. It is available now. □

APPLE TO ENHANCE MACINTOSH BUT NOT RAISE THE PRICE

Apple Computer Inc. is doubling the capacity of the floppy-disk drive and adding a ROM to speed up screen updates and file access in the 512-K Mac Enhanced, the entry-level Macintosh update it is announcing today. The new machine will have the same retail price, $1,999, as the original 512-K Macintosh. It will include an 800-K-byte 3½-in. floppy-disk drive, and a 512-K ROM to cut response time. The Cupertino, Calif., company says the machine would improve the execution speed of some applications by as much as 50%. The Enhanced version will be available at the end of the month. □

TELEDYNE'S MOS FET DRIVER WILL DELIVER A PEAK CURRENT OF 6 A

Teledyne Semiconductor is set to deliver a power MOS FET driver IC that can efficiently handle the emerging very-high-power MOS FETs. The Mountain View, Calif., company's TSC429 will translate a low-power CMOS or TTL input signal into an output that will swing from 0 V to 18 V and supply a peak current of up to 6 A. Currently available MOS FET drivers can supply peak currents of up to 1.5 A. Also, the TSC429 minimizes switching losses in power MOS FETs by rapidly charging and discharging the MOS FET's static and Miller gate capacitances. The TSC429, which will sell for $1.95 each, will swing a 2,500-pF load 18 V in 25 ns. It is available now. □

CMOS BUS-INTERFACE CHIPS USE 80% LESS POWER THAN BIPOLAR VERSIONS

The first of a family of CMOS bus-interface circuits from Advanced Micro Devices Inc. boasts a power consumption 80% lower than that of the Sunnyvale, Calif., company's bipolar counterparts, but it maintains propagation delays as low as 8 ns. Two 10-bit bus buffers—the AM29C823, with inverted outputs, and the AM29C827, with noninverted outputs—are available now in 28-pin plastic and ceramic DIPs. A plastic leaded chip carrier and a military version of the chip will be along in the third quarter, and a small-outline IC package in the fourth. Other buffers, latches, and registers will be added to the new CMOS family later this year. □

PERSONAL CAD SYSTEMS ADDS AUTOPLACEMENT TO ITS DESIGN PACKAGE

Personal CAD Systems Inc., Los Gatos, Calif., has put the finishing touches on its personal-computer-based series of pc-board design-automation software with a module that allows automatic placement of components. With the addition of the PC-Place module, P-CAD now has a complete pc-board design package from schematic capture to automatic placement and routing. The new software will be a $500 upgrade to P-CAD's interactive placement module. It will be available May 26. The P-CAD software runs on the IBM Corp. Personal Computer AT and compatibles. □

Electronics

IBM MOVES A BIG STEP CLOSER TO VOICE-DRIVEN TYPEWRITER

ITS OFFICE-SIZE PROTOTYPE RECOGNIZES 5,000 DISCRETE WORDS

NEW YORK

If the ubiquitous keyboard is ever scrapped as a data-input device, its replacement is likely to be a voice processor resembling the one IBM Corp. demonstrated last week in New York: a voice-driven dictation machine built around a personal computer. The voice typewriter, long under development by IBM, has been shrunk to a few processor boards and is leaving the lab for human-factors testing in the company's offices around the world.

The developers of IBM's machine at the Thomas J. Watson Research Center in Yorktown Heights, N. Y., are calling the 5,000-word speaker-dependent discrete-word recognizer a prototype. They have resolved many of the crucial hardware and software development issues, though, so the salient question now is how long it will take IBM to turn its prototype into a product.

"I'm calling it a tactical technical announcement," says Don Godding, director of research for the Yankee Group, Boston. "IBM wants true-Bluers to put off buying competing products that should start showing up in the next 12 to 18 months." Among the companies said to be readying large-vocabulary recognition systems are Dragon Systems, Kurzweil, and Speech Systems.

ENDORSEMENT. Michael G. Tomasic, chief operating officer of Kurzweil Applied Intelligence Inc., welcomed the IBM annoucement, saying "the demonstration represents an endorsement of the potential of large-vocabulary recognition." The Waltham, Mass., company is testing its own 5,000-word recognizer in-house. It will be ready for beta tests later this year, Tomasic says.

The as-yet-unnamed IBM system—a Personal Computer AT outfitted with seven speech-processing boards and a pressure-zone microphone—demonstrates that the computer giant has mastered the signal-processing and large-vocabulary search algorithms needed to do the job with an office-size unit. According to speech-processing team leader Fredrick Jelinek, the device can transcribe a speaker's voice into text with 95% accuracy, the level that required an IBM 4341 with three Floating Point Systems Inc. 190L array processors just 18 months ago [*Electronics Week*, Oct. 15, 1984, p. 14].

"I think it's great," says Dragon Systems Inc. chairman and CEO James K. Baker, of the AT-based recognizer. Dragon, Newton, Mass., licenses its recognition technology to IBM and is working on a recognizer similar to IBM's. Baker says his company will begin shipping a 20,000-word software-based recognizer this summer, though real-time response must await custom hardware now under development.

RECOGNITION. IBM's Jelinek says experimental recognizer achieves 95% accuracy rate for noncontinuous speech.

IBM representatives say their system's 5,000-word vocabulary covers 93% of the words used in typical office correspondence. A 20,000-word vocabulary that covers 97% is under development.

The AT-based speech system consists of a simple demodulator board to capture the signal from the microphone and two subsystems made up of three boards each. Common to both subsystems are a digital-signal-processor (DSP) board and a host-interface board.

Words are first translated into strings of crucial acoustic and phonetic features, which are labeled by a subsystem made up of the data-acquisition board, a DSP board, and a host interface. The data-acquisition board, which carries analog-to-digital converters and 64-K bytes of memory, "does the interfacing between the real workhorse—which is the DSP—and the preamplifier" in the microphone demodulator board, according to Jelinek.

The DSP board, with 64-K bytes of 55-ns memory, is built around a new CMOS version of an older DSP chip. IBM says the 6,000-gate device executes 10 million instructions/s, which comes to 30 million operations/s when a program performs a data transfer, an arithmetic-logic-unit operation, and a multiplication in a single cycle.

The other subsystem—which consists of another DSP board, a host-interface board, and a memory-management-unit board—matches the labels with the acoustic and phonetic models of the stored vocabulary. The search-and-match algorithms typically eliminate 4,980 words within the first 400 ms; a detailed search and match among the 20 remaining words takes 150 ms. The 2 megabytes of dynamic random-access memory controlled by the MMU operate in a fast-page mode, taking just 300 ns to complete a random read. More typically, though, the DRAM is used to do a sequential read, in just about 100 ns. IBM is not disclosing details of the MMU, but says it was designed especially for the speech-processing application.

Not everyone thinks the discrete-word capability—which requires users to pause briefly between words—will find ready acceptance. "We believe that a continuous-speech recognizer is needed. A user must be able to talk without pauses for the product to be effective in the market," says William S. Meisel, president of Speech Systems Inc., Tarzana, Calif. He says IBM recognizes this and probably will not offer a product until it has mastered continuous speech.

–Robert Rosenberg

TI TO BEAT SWORDS INTO PLOWSHARES

DALLAS

A high-level strategic-objective committee is being formed inside Texas Instruments Inc. to help the giant Dallas chip maker transfer several key emerging technologies from its defense-equipment group, where they have been exclusively used, to TI's semiconductor portfolio. The Military Components Intracompany Objective, which is expected to be announced at this week's annual stockholders meeting, is designed to ease the TI Semiconductor Group into gallium arsenide markets.

In part, the project is an attempt to reverse what have typically been commercial-to-military product-development cycles. Since the 1970s, most military semiconductors have ridden into the defense markets on the coattails of commercial products. TI and other chip makers have narrowed the gap between military and commercial product introductions, but some new defense-component technologies—such as GaAs—enjoy no big commercial demand to spur product development.

The intracompany objective calls for the transfer of technology for military power supplies and static silicon memories as well, but TI's intended entry into the GaAs integrated-circuit marketplace could be its most important implication. Such an entry by a major chip producer into the still-embryonic market could greatly help to win needed confidence in the slow-growing but promising technology, says analyst Ted Wakayama, vice president of Strategic Inc., San Jose, Calif.

Sales of military GaAs components in the U.S. accounted for about $60 million of the total $80 million last year, Strategic says. In 1990, the military will still be the largest GaAs user, buying $300 million worth out of a total of $850 million. Other emerging commercial uses will show great strength, however, including some $250 million of components for advanced computers, Wakayama projects.

In the immediate future, TI plans to bank on the military GaAs business. According to an internal corporate memo issued earlier this month, digital and microwave GaAs ICs will be two tines of a four-pronged product thrust to be made jointly by TI's Semiconductor Group, the Defense Systems & Electronics Group, and Central Research Laboratories.

MILITARY POWER. The third prong is technology developed for military power supplies. In its effort to establish new standards for low-profile high-density military supplies [*Electronics*, March 17, 1986, p. 22], TI has developed power leadless chip carriers, low-profile magnetic devices, and dense filter capacitors, among other technologies.

The fourth thrust is aimed at launching an effort in fast static random-access memories. Military SRAMs will be made from TI's 1-μm Enhanced Performance Implanted CMOS, known as EPIC [*Electronics*, Jan. 27, 1986, p. 16].

TI developed its 1-μm CMOS technology for its 1-Mb dynamic-RAMs. Until recently, officials admit, TI has all but ignored SRAMs as it strove to compete head-on with Japanese memory makers in DRAMs. The intracompany objective calls for 1-μm CMOS to be applied initially to military 16-K SRAMs, with 64- and 256-K parts to follow.

The GaAs components, SRAMs, and power-supply technologies will first be brought into the fold of the Semiconduc-

THE DOCTOR TAKES CHARGE OF SALES AT WANG LABS

BOSTON

For better or worse, An Wang is back in total control at Wang Laboratories Inc. Known as "the doctor" at the Lowell, Mass., company, he has taken over direct control of sales and marketing, prompting the resignation of senior vice president J. Carl Masi, who had run those operations.

Wang's plans call for a decentralized sales and marketing staff to report to him. Observers question whether the move will work, noting his small experience in those areas. However, they say such a move by the man who built the $2.35 billion giant is probably necessary to get the stumbling computer company back on its growth track.

"Wang is trying to get closer control of marketing," says Stephen Smith, an analyst with Paine Webber Inc., New York. This action is "appropriate," Smith thinks, because the company is suffering from a loss of credibility.

But some say Wang is the wrong person to run sales. "He's not someone with the right experience to be intimately involved with the sales staff," says Amy Wohl, president of Wohl Associates, a Bala Cynwyd, Pa., research firm. "His expertise is in product development."

Wang Labs is still smarting from the troubles of fiscal 1985, which ended June 30. It had to lay off 1,600 workers and it suffered a $109 million fourth-quarter loss. That dropped total yearly earnings to $15.5 million. In fiscal 1984, Wang Labs earned $210.2 million on revenue of $2.18 billion.

Wang sees the chief ailment as the company's management structure, consistently described as bloated. "There has been a pattern developing over the last five months," says George Colony, president of Forrester Research Inc., a market researcher in Cambridge, Mass. "Dr. Wang took control. He went to research and development and saw there were problems and fixed them. He went to finance and saw there were problems and fixed them. Now he's going to sales and marketing."

The bottom line has been a cut in management layers. But in using the scalpel, Wang has consolidated control in his own hands to a level many think is unworkable for such a large company. Colony agrees it would be bad if Wang tried to run things by himself for the long term, but thinks Wang is on the right track. "I think this is a prelude to bringing in new management."

There may be problems in attracting the kind of aggressive management that the company needs. Executives might share the frustrations felt by Masi. Any hopes he had of rising to the top were dashed about two years ago. It became evident that then-president John Cunningham would rise no higher in the company, Masi says, and he felt similarly gridlocked. Cunningham subsequently left to run Computer Consoles Inc., Rochester, N.Y.

Terming his departure "amicable," Masi says he refused the offer of another "important" corporate position managing overseas investments, along with internal marketing responsibilities. Most observers now believe the future head of Wang Labs is Frederick Wang—treasurer, executive vice president, and 35-year-old son of An Wang.

The extent to which Wang has reimmersed himself in day-to-day operations is underscored by Masi and others. Wang will visit all 40 sales districts this year and was in Europe on business as news of Masi's departure broke.

Although Wang Labs' image has been battered, one recent survey indicates Wang still has substantial customer loyalty. "I think Wang is a sleeper," says Colony. "We did a survey of Fortune 1,000 companies and found users' faith in Wang has not waned much. The VS [minicomputer] is good. R&D is back on its feet. The problem is management." *–Craig D. Rose*

tor Group's Military Product Department in Midland, Texas. Many of the production facilities, however, will stay in Dallas.

Key to the GaAs side of the effort are a number of breakthroughs achieved in recent years by TI's Central Research Laboratory in Dallas. Topping the list, say research managers, was the world's first single-chip phased-array radar module made from GaAs. The device works in the X band, near 10 GHz. George H. Heilmeier, senior vice president and TI's chief technical officer, says the project needs a couple of years to mature before becoming a military product.

TI has also built a number of heterojunction bipolar GaAs gate arrays, including one with 4,000 gates, for internal use and government contracts. Last year, TI won a contract from the Defense Advanced Research Projects Agency to build a GaAs reduced-instruction-set-computer microprocessor.

TI is also researching mixing other materials with GaAs. Working bipolar transistors and metal-semiconductor FETs have been produced in GaAs grown atop 4-in. silicon wafers. Mercury cadmium telluride has also been grown on GaAs for possible integration of image sensors and signal-processing circuits. *–J. Robert Lineback*

PERSONAL COMPUTERS

APPLE STIRS UP MEXICAN PC MARKET

MEXICO CITY

Unlike in the U.S., Mexico's personal computer market is kicking up a lot of fuss these days. And most of it seems to be coming from Apple de Mexico. Apple Computer Inc.'s joint venture is in the midst of launching two major new products in that country.

NOISY. Apple de Mexico's Tous is hawking translated Mac software.

"We're making a lot of noise right now," says Abelardo Tous Jr., general manager of Apple de Mexico, chartered just 18 months ago.

The big noise this week is that, following months of delicate negotiations with the Mexican government, the Macintosh is coming to Mexico. In May, the company will begin heavily advertising the Mac Plus and Mac 512, stressing the availability of Spanish versions of "the whole Mac software line," says Tous.

Just six weeks ago, Apple de Mexico introduced an upgraded version of the Apple IIe, dubbed the Apple IIe Turbo System. With increased speed and more memory than the basic IIe, the Turbo System is designed to meet the needs of small to medium-size businesses.

Apple Computer Inc. offered a similar IIe system in the U.S. last October, but as an upgrade item. "Mexico is the only country where the Turbo has been presented as a new concept," says Tous.

Apple de Mexico is the Cupertino, Calif., company's only joint venture. Under Mexico's Foreign Investment Law, Mexicans must own at least 51% of any foreign venture here. Tous says that's exactly how much Apple de Mexico stock is owned by Mexican citizens.

Although integrating the U.S. and Mexican components has created some problems, Tous and other Apple officials say the company hopes to market the Mexico-assembled Turbo to other Latin American countries—particularly Brazil, Argentina, and Colombia—now closed to foreign-controlled computer firms. "For us, Mexico is the pivotal market from which we expand activities to the rest of the continent," says Javier Ergueta, Apple's marketing manager for Latin America.

"We believe the whole economic model of Latin America is opening up, changing to less protectionism," says Tous. "Countries are realizing they cannot lag in technology from the rest of the world. They may still not be willing to accept something like IBM with its 100% ownership, but they may like the fact that in Mexico, Apple has proved it can work as a partnership."

Mexico represents 70% of Apple de Mexico's sales. In descending order, other markets include Venezuela, Chile, and Ecuador. Xerox Corp. handles Apple sales in Latin America outside of Mexico.

Overall, says Tous, Apple de Mexico "has surpassed our original goals. We planned for a company half the size we are now. We felt the economic crisis here would hit us harder."

Mexico's economic woes, particularly tight credit for businesses, had led to a 20% to 25% softening of the microcomputer market in the last six months, Tous notes. Still, he adds, this year Apple de Mexico will nearly double its 1985 sales of $20 million.

TWO PLAYERS. Tous says independent studies have shown that Apple controls 35% of the Mexican market for microcomputers priced over $1,000. About two dozen companies selling IBM Corp. Personal Computer-compatible lines control the rest of the market.

Though the numbers may look good for Apple, some observers say the company is facing a serious challenge from the PC-compatibles. Apple officials acknowledge that the Turbo was introduced because Mexican businesses were dissatisfied with the regular IIe model.

"Without the Mac, Apple's competitive position would be very weak," says Miguel Angel Lopez-Bracho, of the Technology Transfer Office of Mexico's Secretariat of Commerce and Industrial Development. "Our businesses are very attracted by what the [IBM] PC line has to offer them." *–Phil Primack, McGraw-Hill World News*

DISPLAYS

ARMY FUNDING PAYS OFF IN THIN-FILM EL DISPLAYS

FORT MONMOUTH, N. J.

Flat-panel displays are the talk of the town these days, with TV and computer makers rushing to market with the latest in liquid-crystal and plasma display technologies. But these products don't excite military users, who want larger, clearer screens than those technologies can offer. That's why the Army—one of the largest potential consumers of flat-panel displays—has been funding research into thin-film electroluminescent displays. Now, several years and many millions of dollars later, the investment may be about to pay off.

Labcom, the Army's laboratory command group, has made a high-resolution 10.1-by-12.6-in. flat-panel EL display that has the gray scale needed to display video signals. With 512-by-640-pixel resolution, the screen is the largest and sharpest of its kind, says M. Robert Miller, leader of the display devices team at Labcom's Electronics and Devices Lab-

THE ARMY WANTS A COLOR EL DISPLAY, TOO

Reproducing living color on a flat-panel display is the goal of Richard Tuenge, senior scientist at Planar Systems Inc., a Beaverton, Ore., maker of electroluminescent displays. He says Planar will show off a multicolor (but not full-color) EL screen next month at the Society for Information Display conference in San Diego. Funded by Labcom, the Army's laboratory command group at Fort Monmouth, N.J., Planar has been working on the project for 18 months.

The new display uses two phosphor layers, one green and one red, made up of zinc sulfide activated by rare-earth ions. Each color has its own frequency-differentiated gray scale, and by concurrently activating overlapping pixels, other colors can be created. Planar's contract with Labcom calls for the company to add a blue layer, which will allow full-color imaging, later this year.

The phosphor layers are separated by a transparent electrode layer. "That's the key," Tuenge says. "You need to have transparent electrodes that won't burn out, short-circuit, or show through." Improvements in the reliability of the transparent electrodes, more efficient phosphors, and custom drive chips, however, will be needed to make such displays something other than one-of-a-kind laboratory prototypes.

The prototype measures 4.8 by 3.6 in. and has 320-by-240-pixel resolution. Tuenge says Planar has no short-term plans for color EL display products, but he projects that the company will market color products starting in 1988. Before that can happen, however, the company will have to bring the cost down from its current level—almost $1,500 for a panel the size of the prototype. *–T. N.*

oratory at Fort Monmouth in Eatontown, N.J. It is the first EL display capable of showing a live TV image.

The Army likes EL displays because they offer contrast superior to that of both LCD and plasma technologies and because they have a "steep threshold-voltage characteristic that allows us to drive a 512-line display without getting crosstalk—streaking or banding—and losing contrast," Miller says. Industry has shied away from the technology because of its appetite for power, but Miller claims Labcom has overcome that problem.

The amber display, in fact, is frugal with power. Power consumption is only about 25 W now, and researchers are already looking at ways to build an energy-recovery system into the display that can cut consumption to less than 10 W. The new display is also comparable in weight to like-sized LCDs: just 6 lb, including its support circuitry.

DRIVEN. Key to the screen's ability to display a high-quality video image is a new set of EL drivers that Supertex Inc. developed specifically to produce a 16-tone scale on an EL display, says Elliot Schlam, director of Labcom's Integrated Device Processing and Displays Division. The CMOS drivers use the Sunnyvale, Calif., chip maker's HVCMOS high-voltage technology to keep power requirements to a minimum.

To ensure that the parts met military standards, Labcom developed its own high-voltage tester for the CMOS chips, which are packaged in compact 36-pin leaded quad-type ceramic chip carriers to optimize board density. Supertex designed the chips to be suitable for displays with resolutions of up to 1,000 by 1,000 pixels.

GTE Product Corp.'s Engineering Center, Salem, Mass., produced the display panels, which use indium tin oxide and aluminum electrodes to excite the screen's manganese-activated zinc-sulfide phosphor layer. Planar Systems Inc., a Beaverton, Ore., display maker working separately with Labcom to develop a multicolor EL display (see "The Army wants a color EL display, too"), is also supplying screens, Schlam says.

Surprisingly, the hurdles Labcom had to overcome in producing such a screen were not all high-technology leaps. Miller points out that processing the glass and patterning the electrodes for a screen of that size required only the development of larger process chambers.

Hycom Inc., Irvine, Calif., was brought in to assemble the various components into a working display.

Schlam says getting the three companies to work together to produce the screen was difficult because they were all reluctant to share trade secrets. Schlam likens Labcom's role to that of an architect and general contractor, pulling all the pieces together. "We're the architects. None of these people would have been doing these things if it weren't for us," he explains.

Labcom drove the technology, he says, because industry wasn't inclined to. "Five to eight years ago people told us, 'Hey, you're bucking the tide. You'll never be able to make a cheap low-power EL display.' But with this, I think we've shown that we were right. It can be done." *–Tobias Naegele*

WILL IBM CONVERTIBLE SPARK LCD AFTERMARKET?

BOSTON

IBM Corp.'s Convertible may yet become known as the Upgradable. The laptop computer's easily replaceable liquid-crystal display makes it an ideal candidate for upgrades as screen technology advances. For the time being, however, flat-panel-display vendors are assessing what IBM's entrance into the laptop market may mean to them, and conclude that it's a mixed bag.

Most important, in the view of display makers, is that Big Blue's presence raises the market's visibility and serves as an endorsement for LCD technology. If sold in large volume, the laptops might also provide a significant aftermarket in display panels. The Armonk, N.Y., giant is making life easier for those interested in this market by publishing a definition of the display interface in a technical reference manual.

SCREEN TESTBED? IBM's Convertible laptop computer invites improved flat-screen types to upgrade its standard LCD.

But then again, IBM's twisted-nematic display appears to do little to rehabilitate the battered image of LCD created by earlier products. Flat-panel-display makers have "all been burned because of LCD problems, and as far as we know the screen [IBM] introduced has not remedied that situation one bit," says Jim Hurd, president of Planar Systems Inc., an electroluminescent-display maker in

Beaverton, Ore. Emphasizing that he had not yet seen the IBM screen, Hurd said it sounded "pretty conventional."

He argues that EL panels will solve many problems associated with LCD. The technology and pricing for those displays are already in hand, he says; the primary obstacle now to widespread use of EL is availability. "Until we can get production up, it will be difficult to service [IBM's laptop] market at volumes they'd like," he says.

But present EL displays require significantly more power than LCDs. And IBM's laptop design provides only enough power for LCD, making LCD upgrades more likely in the short term.

One option is an LCD class called super-twisted-nematic displays, which offer better contrast than IBM's displays at a comparable price. But STN displays have a color cast, such as yellow background with blue lines, which IBM apparently rejected.

Another upgrade option, active-matrix LCDs, has been languishing. The LCD market not only hasn't grown as forecast, but oversupply and excessive competition are driving prices down, says Shinji Morozumi, general manager of the basic research and development department at Seiko-Epson Corp., which has developed metal-insulator-metal active-matrix displays [*Electronics*, Oct. 6, 1983, p. 101]. Before the weak market brought development to a halt, prototypes with 640 by 400 pixels had been developed. That compares with the IBM display's 640 by 200 pixels.

If IBM's laptop brings the market to life, Seiko-Epson may reconsider investing in production facilities, says Morozumi. He adds that business is brisk for LCD-based TVs, but the low prices depress the bottom line. If the IBM Convertible sells well, its large displays could represent a market likely to attract investment. One year or more would be required to ramp up production for a new type of display, he adds.

A plasma-screen upgrade could come from IBM itself, suggests Charles Apt, vice president of Arthur D. Little Inc., Cambridge, Mass. "IBM has made plasma screens for bank terminals for many years." But he notes that the 12-lb IBM laptop may turn out to be too heavy and too expensive, at $1,995, to sell in large volume. *–Craig D. Rose and Charles L. Cohen*

SEMICONDUCTORS

JUST WHAT HEMTs NEED: A GOOD DRIVER

TSUKUBA, JAPAN

High-electron-mobility transistors—HEMTs—very likely will play an important role in the supercomputers of the future. But the drive limitations of these gallium arsenide FETs have had researchers looking for a companion circuit element that can drive a chip's output lines or large-fan-out circuit nodes.

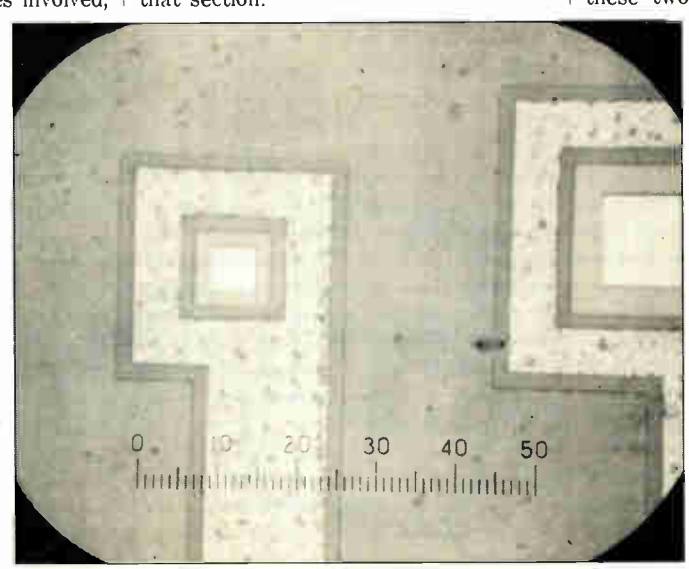
A team of Japanese researchers thinks it has found that missing element in the GaAs inversion-base bipolar transistor, a very fast device unique among its bipolar brethren because its base structure is not made with a doped semiconductor layer. An inversion layer controls the flow of electrons from emitter to collector, replacing the conventional base region.

In terms of complementary capabilities and the production technologies involved, the inversion-base transistor (IBT) forms a very attractive combination with a type of HEMT called a semiconductor-insulator-semiconductor FET, or SIS FET, conceived earlier by the same team. These devices, which do not employ the modulation-doping technique used by most other existing HEMTs, can be built on the same chip with IBTs.

With SIS FETs handling the high-density logic chores and the power-handling capabilities of the IBTs used judiciously around a chip's periphery for input/output functions, GaAs could come into its own in the next generation of low-temperature supercomputers, according to members of the Japanese team. Tests show that IBTs can operate at 77 K, the temperature to which HEMTs are often cooled when maximum performance is required.

FETs provide higher packing density and operate at lower power-dissipation levels than bipolar devices such as the IBT, but they do not provide sufficient drive for off-chip circuits or high fan-out. Like other bipolar devices, IBTs can drive off-chip circuits at high speeds, but they consume too much power for use at the highest integration densities.

The concept of the IBT was developed by three researchers at the government's Electrotechnical Laboratory in Tsukuba: Yutaka Hayashi, head of the Semiconductor Device Section; Kazuhiko Matsumoto, of the Solid State Device Section; and Nobuo Hashizume, head of that section.



FAST DRIVER. The inversion-base bipolar transistor can perform high-speed line-driving chores, helping out HEMT-based logic on GaAs chips.

Hashizume, Matsumoto, and Takafumi Yao, head of the Applied Physics Section, worked together to build experimental IBTs. These are easier to fabricate and have better characteristics than the heterojunction GaAs bipolar transistors that some other laboratories have been working on, the researchers say.

2-D ANALOG. The base region of the IBT, like the channel of a silicon MOS FET, is an inversion layer that only exists when the voltage conditions are right. Physically, the inversion layer is very similar to the two-dimensional electron gas that forms the channel in modulation-doped HEMTs. The base of the IBT is composed of a 2-d hole gas, however—the positive analog of the negative 2-d electron gas in such HEMTs.

Except for polarity, the properties of these two types of charged gases are similar. They are very thin—typically tens of angstroms thick—making both gases effectively 2-d. Moreover, they both provide high carrier concentration in a region with a low doping level, which makes for high carrier mobility. Carrier mobility is high in the regular lattice of undoped GaAs but decreases as doping density rises because dopants impede carrier flow. This is the primary reason that HEMTs exhibit superior characteristics compared with metal-semiconductor GaAs FETs.

The transit time for electrons injected into the inversion region of an IBT is extremely short because of the layer's thinness. The hole

gas's high mobility also results in low base resistance, another speed factor.

IBTs are fabricated on an n-type GaAs substrate by a molecular-beam-epitaxial process in which a thin barrier layer of aluminum arsenide and the n^+ GaAs emitter are successively grown. The AlAs layer forms a heterojunction with the GaAs emitter, insulating it from the GaAs collector. Voltage across this barrier induces the inversion layer that forms the intrinsic base structure, and an ion-implanted p^+ region extending into the GaAs substrate forms the extrinsic part of the base.

SIS FETs may be easier to make than other HEMTs

For base-emitter voltages above the threshold needed to induce inversion, electrons are injected into the base, and the device behaves like a transistor. The threshold voltage is analogous to the base-emitter junction forward voltage drop in conventional transistors.

Experimental devices have been made with a 50-by-50-μm emitter to confirm their static characteristics, but a device with an emitter line width of about 1 μm will be required to demonstrate the expected high-frequency characteristics.

Fabrication techniques for the IBT are similar to those for SIS FETs. Like the modulation-doped HEMT, the SIS FET is a conductive-gate FET with a layer of gallium aluminum arsenide sandwiched between the gate layer and the GaAs substrate. The major difference between the two types of devices is that silicon doping is not used in the GaAlAs layer of the SIS FET.

In the modulation-doped HEMT, the fixed charge in the GaAlAs layer induces a 2-d electron gas in the underlying undoped GaAs layer. But the fixed charge is not necessary for the device to operate as a FET. When there is no fixed charge, the GaAlAs layer functions as the gate insulator, and the voltage that is applied to the gate induces the inversion layer.

Experiments at the Electrotechnical Laboratory show that the SIS FET should be easier to fabricate reproducibly than other HEMTs: elimination of the fixed charge makes the device threshold voltage insensitive to growth and process parameters. Both n- and p-channel SIS FETs have been integrated on a single chip. *–Charles L. Cohen*

IC TESTING

HIGH-LEVEL SIMULATOR SPOTS CHIP FAULTS EARLY

PRINCETON, N. J.

High-level fault simulation is the engineer's choice when time is critical, but such programs trade thoroughness and reliability for speed. Running in a fraction of the time of gate-level simulators, they tend also to produce overoptimistic results because they find faults only at the input and output pins of functional chip models—not at the gates inside. AT&T Co. researchers say they've mastered that problem, though, with a high-level fault simulator that can detect internal as well as pin faults.

The researchers are already beginning to use this approach, called ESIM/AFS for engineering simulator/architectural-level fault simulation, to check out very large-scale integrated circuits. They see the program less as a replacement tool for gate-level fault simulators, though, than as a completely new step in the design process. If used immediately after initial simulation of the circuit's operation, the program could help designers spot problems with a chip at the earliest possible stage, says Scott Davidson, supervisor of the Automatic Test Generation Group at AT&T's Engineering Research Center in Princeton.

Adding another step to the already tedious chip-design process may not be most people's idea of streamlining the task, but Davidson says that's just what designers need. The program can now do fault simulation of a typical 200-gate chip with 36 vectors in 43 s on an AT&T 3B20 computer with 2 megabytes of memory, Davidson says. "But we're still increasing performance," he adds. "We can probably double the speed on that."

Davidson says the program can actually anticipate how faults might occur within the individual IC devices. The program models the data path of a bit of information traveling through an IC component by comparing the input to the anticipated output.

POTENTIAL FAULTS. After creating this model, ESIM/AFS can figure out where in the components faults might occur and alert the designer accordingly. "You have a good idea of what's in the box," he explains, referring to the functional model of a hypothetical component within an IC.

Davidson says he tries to "abstract out" what goes on inside the functional components in ICs. "This is not a random description of what's going on in there. In some ways, you're thinking about what goes on inside that circuit, and you're faulting your C-program accordingly. You know more about it than you think you do."

Architectural-level simulation mimics a chip's actions function by function rather than gate by gate, so no matter how smart ESIM/AFS may be, it isn't likely to replace the gate-level simulation designers do at the end of the design process, Davidson says. Gate-level simulation is the most comprehensive way to identify potential faults, but it is also far more complex, time-consuming, and demanding of computer power than the architectural approach.

That's a big reason why the program is replacing AT&T's LAMP (for Logic Analysis Maintenance Planning) gate-level fault simulator on VLSI chips that might take a week to do using LAMP. ESIM/AFS can run on virtually any computer an AT&T engineer might be using, from "a Unix personal computer to a mainframe."

EARLY DETECTION. AT&T's Davidson says his ESIM/AFS program can help designers recognize chip problems early.

Davidson developed the first version of ESIM/AFS himself, building on ESIM, an in-house general-purpose simulation program. On that base Davidson created a sequential fault simulator, which simulates faults one at a time. Subsequently he and fellow technical staff members James Lewandowski and William Gilroy took the program a step further by developing a more powerful concurrent simulator that can simulate all a circuit's faults at once.

ESIM/AFS, which can also be used for fault simulation of printed-circuit boards, is now moving out of the laboratory and into

"the phase of introduction and optimization," Davidson says. And optimization is the name of the game at the research center, where the thrust of the activity is to improve the manufacturing process at AT&T's various plants worldwide.

"If you catch most—98%—of the stuck-at faults [permanent voltage or ground applied at a pin], you'll catch most of the short-circuit faults also—and you'll have good yield," says Davidson, who is hoping to present a paper on his ESIM/AFS work at September's International Test Conference in Washington. "You catch 60%, and you'll have terrible yield." *–Tobias Naegele*

INSTRUMENTS

THE INSTRUMENT THAT CAN DO ALMOST EVERYTHING

WEST BERLIN

A measuring instrument that works as a digital oscilloscope, a transient recorder, a frequency counter, a signal processor, a sampling scope, and a digital voltmeter is on the way. What's more, this versatile unit wedges all these functions into a package about the size of a hand-held notebook.

Called the SC01 signal computer, because it combines signal analysis and computing functions, it is the first major product from three-year-old Createc GmbH in West Berlin. It is one of the star attractions in the electronics display area at this month's Industrial Fair in Hanover, West Germany.

Despite its size—the unit measures 26 by 10.5 cm and is only 4 cm thick—the 21-oz SC01 sports impressive performance for each application. In its oscilloscope function, the instrument shows aperiodic signals sampled at a rate of 20 MHz. As a sampling scope, the SC01 is suited for periodic signals, displaying them with a resolution of 50 ns/division.

When it's used as a transient recorder, nine nonvolatile memories (each storing 256 horizontal dots for the display) and one memory for the operating mode come into play. As a digital voltmeter, it measures root-mean-square voltages from 0 to 60 V over a frequency range of 1 Hz to 1 MHz. The frequency counter is accurate to within 0.05% for signals up to 6 MHz, and the digital signal processor operates on two voltages to add, subtract, multiply, or divide them.

Manfred Koslar, general manager and developer of the signal computer, thinks the instrument can be sold for a little more than $1,000. Mounting of components on printed-circuit boards is contracted to another company, and Createc handles instrument assembly and quality control.

West Germany's Ministry for Research and Technology covered about 40% of the instrument's development cost. But the market is not limited to Germany; Koslar is about to enter negotiations with a U. S. instrument company interested in selling the signal computer in the States.

HANDY. The SC01 signal computer is a hand-held, notebook-size unit.

Essential to the instrument's small size, says Koslar, is the rigorous use of very large-scale integrated circuits, including microprocessors and microcomputers. "We thoroughly surveyed the American and European markets to get the best available," he says. The application of miniaturized slide switches, bus connectors, and other mechanical parts made especially for Createc by other companies also contributes to the unit's size. Use of the space-saving surface-mounted-device technology in pc-board production helps, too.

The 6-by-6-cm display also contributes to the unit's compactness. A Japanese design, the liquid-crystal display uses a multiplexed matrix and 128 by 128 dots. It's controlled by a Createc-designed graphics controller.

The instrument's architecture is based on four processors, and an 80C31 microcomputer with a 64-K read-only memory serves as the main processor. Besides handling organizational tasks, it controls the other three processors, one each for the keyboard, the LCD, and the converter. Also distinguishing the SC01 are auto-calibration, two-stage broadband measuring amplifiers for signals extending from dc to 10 MHz, and a flash analog-to-digital converter.

PROGRAMMABLE. The instrument has a feature that is common in logic analyzers but unusual for scopes: it can be programmed for a post-trigger function for 256 samples and for a pretrigger mode for 4,000 samples. The two-channel scope works with two independent horizontal scaling factors and two time bases for each channel. All key functions, such as selecting scaling factors, searching for trigger parameters, and calibration, are handled automatically.

The operator can program the instrument with the keyboard and positioning switches. Consuming only 3 W, the signal computer has backup nickel-cadmium batteries that protect stored data for at least three months. *–John Gosch*

BUSINESS ABROAD

TWO GIANTS WEIGH INTO EUROPE'S ASIC MARKET

PARIS

Two of Europe's largest chip makers are taking aim at a wide-open home market that's ready to soar: application-specific integrated circuits. Their efforts compete with those of a fledgling company launched with the most substantial venture-capital backing yet seen outside the U. S.

Italy's SGS Microelettronica SpA and France's Thomson Semiconducteurs are reorganizing their MOS divisions for quick response to fast-turnaround, low-volume orders for prototype ASICs. The market sector's untapped potential was behind last year's founding of European Silicon Structures [*Electronics*, Sept. 16, 1985, p. 30], based in Munich and trading under the name ES2.

Both Thomson and SGS stress that their moves to attack this sector resulted from their own market analyses and were under consideration well before the creation of ES2 was announced. In addition, their motives are somewhat different. ES2 plans to limit its production of a given IC to those quantities, usually measured in hundreds, that can be economically turned out using electron-beam direct-wafer writing. SGS and Thomson are looking at the prototype business as a way of getting an inside track on ASICs that will eventually become high-volume parts.

OPPORTUNITY KNOCKS. Noels of Thomson sees "a real opportunity" to take a major share of Europe's ASIC market.

ES2 plans to achieve its fast turnarounds at low cost by using the Aeble e-beam direct-wafer-writing system from Perkin-Elmer Corp. to avoid the expensive, time-consuming production of IC masks. When its customers are ready for volume production, they will place orders with one of the European wafer-fabrication lines with which ES2 maintains process compatibility.

Because their strategies differ from ES2's, SGS and Thomson will be tackling the market from a different technological angle. Each chip house will establish separate marketing entities, but both will use tried-and-true in-house technologies to meet the demand, at least at the outset—both say they may use the e-beam approach in the future. All three companies will be relying heavily on silicon compilers and computer-aided design systems to help the customers' own engineers turn out designs for the final products.

SGS is setting up an independent company with its own wafer-fab, design, assembly and test, and marketing facilities just down the road from its headquarters in Agrate, Italy. The company can race through the production cycle to silicon prototypes in a week and a half for gate arrays and in twice that time for cell-based circuits, reckons deputy managing director Pietro Palella. ES2 projects an average turnaround cycle of two weeks. SGS intends to employ some 300 workers in the new company, exactly the total number of employees ES2 projects to have by year's end.

Thomson will divide its MOS Division into a facility for the production of commodity chips in Rousset, near Aix-en-Provence, thus leaving its factory in Grenoble to concentrate on ASICs. It is from Grenoble that, with the help of test and assembly plants in Aix-les-Bains and Nancy, the French company will attack the same market as SGS and ES2.

The time is ripe to do so, says Jacques Noels, president of Thomson Semiconducteurs. For one thing, European semiconductor consumption constitutes only 19% of the world market, whereas demand for ASICs in Europe equals 24% of the corresponding world market. Another key point is that no IC producer has yet taken a dominant role in European ASICs.

"If you take as an example the world gate-array market, you'll see that over 70% of it is supplied by five U.S. and Japanese firms," he explains. "But in Europe, the five largest suppliers—LSI Logic, Thomson, Plessey, National Semiconductor, and Marconi—control only between 3% and 6% of the market each, or a total of 20%. The other 80% is held by companies with less than 3% [each] of the market. In a market that is as fragmented as this, there is a real opportunity for certain suppliers to take a major share."

All three companies agree that the market potential is the essential point. For its part, ES2 is not surprised at the presence of other players in the market. "We know that we're going to get competition—there's no question about that," admits Jean-Pierre Demange, ES2's vice president for operations in Western Europe. "But the question for us remains whether or not we can meet our business plan, whether we can do what we said we would. The way things are progressing so far, there is every indication that we will."

Though ES2 was founded just last year, it has plenty of resources. Seven of its shareholders are large European companies—British Aerospace, Brown Boveri, Bull, Olivetti, Philips, Saab, and Telefonica—a group that translates into an impressive list of customers for any startup. *–Robert T. Gallagher*

U. S. FIRMS SLOW TO GET PRODUCT OKs FROM JAPANESE

U. S. players really made their presence felt at Communications Tokyo '86 as 47 companies, nearly double last year's number, made contact with potential Japanese customers. Yet their European competitors have been more aggressive in establishing markets since Japan liberalized its market-entry regulations last year. Only 6 of the nearly 30 companies that have received approvals for their telecommunications products into the Japanese market are American, while 20 are European.

"The Japanese market is now essentially open to foreign makers," says Jack McDonnell, vice president for the Electronic Industries Association's Information and Technologies Group. "But it could be closed tighter than a drum by the end of next year if our firms don't get in here and do some marketing."

Major market opportunities are in smart modems, voice-message systems, local-area networks, and microwave-network switches, he says. "It's tough to convince a company that is growing 30% annually in its home market to get out and invest overseas," McDonnell admits. "But there's a 'Buy American' flag out right now."

Local EIA representative Mark Foster says he has "more applications than I can handle" from Japanese makers who want U.S. equipment. Adds McDonnell, "It would be ironic if, after all our work last year at opening up this market, the companies that come in and benefit the most turn out to be non-U.S."

McDonnell says he was greatly encouraged by the attendance jump at Communications Tokyo. No major sales were announced, but foreign makers can now take advantage of a greatly simplified equipment-approval process that resulted from last year's U.S.-Japan telecommunications negotiations. Under the new regulations, a foreign maker can submit its own specifications and test data, fill out a simple approval request form, and get approval within weeks.

The EIA office in Tokyo is serving as a liaison for member companies that do not yet have offices in Japan, helping them process applications with the Japan Approvals Institute for Telecommunications Equipment. The latest company to take this easier route is Contel Financial Systems Inc., Atlanta, whose subsidiary, IPC Communications Inc., sees a lucrative business in Japan for its Electronic Turret Trading System. IPC, which claims a world market share of close to 75% for its financial trading systems, will begin marketing in Japan by the end of May. *–Michael Berger*

INSIDE TECHNOLOGY

'NICKEL AND DIME' GROWTH ADDS UP IN PC SOFTWARE

DEVELOPERS ARE BUSY ON A BROAD RANGE OF NICHE PRODUCTS

by Alexander Wolfe

The heady days of the microcomputer revolution may be all over, and with it new software best-sellers that sell by the millions of copies. But today's maturing market is certainly no slouch; it's growing at a "sane" rate of 20% annually, and microcomputer software developers are busier than ever developing a broad range of new products that some experts call a "nickel-and-dime" expansion. But those nickels and dimes add up.

This fragmenting software market covers a multitude of vertical or niche applications. With personal computers offering more raw horsepower than ever, the big guys in personal software are working on packages that turn the broad horizontal programs such as spreadsheets into specialized products for engineers and manufacturers. They are also integrating software so that information for one program can be immediately sent to all other on-line applications, and are developing data bases that use natural languages—replacing complex specialized programs with simple English commands—to obtain data easily and quickly. And software writers are working hard to apply artificial-intelligence techniques to a widening range of programs; for example, a 100-rule expert system will soon run on an IBM Corp. Personal Computer AT.

MICROCOMPUTER SOFTWARE SALES IN 1985

	Units (thousands)	Dollars (millions)
Worldwide total	86,267.3	9,903.0
U.S. total	38,934.3	5,238.6
U.S. subtotals in major software categories		
Productivity	9,311.7	2,064.4
Business	2,469.0	1,415.5
Instructional	4,621.8	242.2
Systems	14,830.2	1,036.4
Scientific and technical	544.9	229.7

SOURCE: DATAQUEST INC.

There are a lot fewer software developers these days, but several personal software pioneers are trying to repeat their earlier successes by starting new ventures. The bulk of microcomputer software being developed today is for IBM PCs and their clones. A distant second is Apple Computer Inc., which should pick up plenty of software developers as its Macintosh turns into an open system.

Even the experts disagree significantly on the size of the microcomputer software market. One of the more bullish is Future Computing Inc. in Dallas, which says that 61.8 million microcomputer software packages were sold in the U.S. last year, yielding revenue of $6.221 billion. On the other hand, Dataquest Inc., the San Jose, Calif., market researcher, estimates that 1985 revenue totaled $5.238 billion, with only 38.9 million units sold. Worldwide, Dataquest says that sales totaled 86.3 million units, which amounted to $9.9 billion in revenue (table). But no one seems willing to estimate what the annual revenues will grow to over the next few years.

Leading the way is Lotus Development Corp. in Cambridge, Mass., which achieved its position with its best-seller, 1-2-3, an integrated spreadsheet. Nearly 190,000 packages were sold last year, according to Future Computing. In 1985, Lotus earned $38.1 million on total revenue of $225 million. While some observers believe that growth in the spreadsheet market is beginning to slow, Lotus maintains that spreadsheets will continue to do well as long as microcomputers are sold.

"I believe the base spreadsheet technology is very robust and very powerful," says Edward J. Belove, vice president of corporate research and development at Lotus. "People talk about replacing the spreadsheet, and that's not going to happen. What I think will happen is you're going to see a lot more powerful tools to help people build, use, maintain, document, audit, and verify the spreadsheet itself, to the point where some spreadsheet users may never actually look at the sheet."

As one example, Belove points to the Human Access Language program—HAL, for short—a natural-language front-end that will be offered for 1-2-3. HAL was developed by GNP Development Corp., Pasadena, Calif., which Lotus acquired recently. Belove balks at the natural-language designation. "Natural language is one of the most misleading terms in the world. Nobody has a natural-language anything right now. What we have are significantly easier and more natural command interfaces. What HAL does is enable you to type in things like 'graph sales,' rather than having to go through the setup that 1-2-3 requires."

Dimensionality, or the ability to examine data on different axes, is another key spreadsheet issue. Here, the challenge is adding functions while keeping the software comprehensible to the user. Belove believes that the issue can be attacked on two fronts. Programs can be developed to combine information from multiple independent spreadsheets. A second tack is software to allow individual cells to access data bases.

"The spreadsheet is like the assembly language of its genre," according to Belove. "You need a way to express your problem at a higher, more abstract level than the individual [spreadsheet] cell and need a tool that can build the spreadsheet for you. And I think we'll see a lot more of that."

UNEXPECTED APPLICATIONS

In a recent survey, Lotus found that 500,000 engineers and scientists were using the company's spreadsheet products; that group accounted for about 20% of all Lotus spreadsheet users. And despite spreadsheets' association with financial number-crunching, the survey uncovered many surprising new uses.

"In one case, 1-2-3 was being used to test the viscosity of salad dressing. We found Symphony [Lotus's integrated software package] on the shop floor, collecting shop-floor data," notes Sandra Gunn, vice president of Lotus's new Engineer-

ing and Scientific Products Division. That's possible because a spreadsheet package like 1-2-3 is actually an interpreted programming language, which can be used to express algorithms for large numerical-analysis problems such as the solution to partial differential equations.

Armed with this information, Lotus this month is launching a new division to cater to these emerging engineering and scientific software markets. The corporate manufacturing sector employs 70% of the engineers and scientists in the U.S., according to Gunn, making it a large target market.

Until recently, manufacturing was the beyond the reach of microcomputers. Manufacturing design, production, and control encompassed technologies such as computer-aided design, automated materials handling, and robotics. These required heavyweight processing hardware.

Now that is beginning to change. "The big push has come from the [IBM PC] AT," says Gunn. "At the same time that the AT made its debut, dedicated [computer] systems were becoming passé in the minds of modern manufacturing people. Dedicated systems didn't integrate, and computer-integrated manufacturing was seen as the manufacturing strategic goal."

The PC AT, Gunn points out, was ideal for the manufacturing environment, but there was no manufacturing software for it. To remedy this problem, the new division has formed a core group of some 30 people (from Lotus's 1,100 employees worldwide), most drawn from other Lotus divisions; some 25% have backgrounds in engineering-oriented companies.

Lotus is also investigating new ways to deliver data to software users through its Information and Services Division. The first step in that strategy, Signal, delivers real-time stock-quotation information directly to microcomputers by FM broadcast. Behind the FM system sits a satellite network to route the information around the country from stock ex-

HOW MICROCOMPUTER INDUSTRY LEADERS SEE IT

PHILIPPE KAHN
Founder and president, Borland International

"The trend is innovation. You have more power available than ever, more technology available than ever. I believe the problem right now is not hardware, it's software. The user cares whether the problem he has is solved by the application. So the perception of the user on progress will come with advances in software more than advances in hardware."

PORTIA ISAACSON
Chairman and chief executive officer, Intellisys Corp.

"The growth of the industry is naturally slowed because it's 10 years old. The number of participants in the personal computer industry, including manufacturers and software companies, has decreased a lot over two years ago because there were too many participants to start with.

"The growth from this time forward will be in the sane range, 20% per year in general. The market for software itself is very good, but it will be served by fewer and fewer companies.

"I think we're seeing a lot of expansion in various vertical markets. Its a nickel-and-dime expansion, but it's really important that finally those verticals are being served. A good example is desktop publishing, a really important, big vertical market that couldn't have existed without the laser printer."

ROBERT CARR
Chief scientist, Ashton-Tate

"The market is fragmented. We're at the end of a golden era in which you just marketed one version of your software and it ran on all the hardware that existed out there. The hardware is going to be fragmented—we're no longer going to have a single standard. It's going to be a high-end machine and a low-end machine. The high-end machine is going to use a 286 or 286-based chip, running in Protect mode, and eventually there will be a lot of software that will only run in that environment. Your low-end machine is going to have an 8088 and [a] monochrome or color graphics adapter interface. And a big question is whether or not we'll continue to see new software for those machines or today's best sellers selling on those."

DANIEL S. BRICKLIN
Founder, Software Garden

"Software doesn't move very quickly. If you look at advances in software, they occur in five-year boundaries. We have an incredible base upon which to do applications, but we're talking about some applications that take three to five years to develop.

"Every product on paper looks like it's going to sell a hundred million dollars worth. When you're developing something, you can't listen to the naysayers, or you'll never get it done. There are companies out there that have been plowing away at it and now they're very successful. They're not well known, necessarily.... If you have a good product, a hit, it forgives a lot of sins."

EDWARD J. BELOVE
Vice president, research and development, Lotus Development Corp.

"The market isn't such that you can just have something come in and overnight take a major market share with the kind of massive growth that 1-2-3 had. Because it's a maturing market, you're dealing with longer buying cycles, more sophisticated users, corporate purchasers. Even if you brought out the greatest product in the world today, it would have to build up at a much slower rate."

GARY KILDALL
Chairman, Digital Research Inc.; President and founder, KnowledgeSet Corp.

"AI does have a very important place in our technology. As long as we don't overuse it to the point where people say, 'AI means any program that seems to act like a friendly program or talk in English,' then it has very good applications. For example, in vision processing we're going to see all sorts of neat things—recognition of objects and movement.

More fundamentally, in things that are just day-to-day, AI can be very helpful in knowledge processing .... It's at the point where we can actually roam around through a data base, do the linkages and interconnections to a program based on the context that [the user is] currently working in."

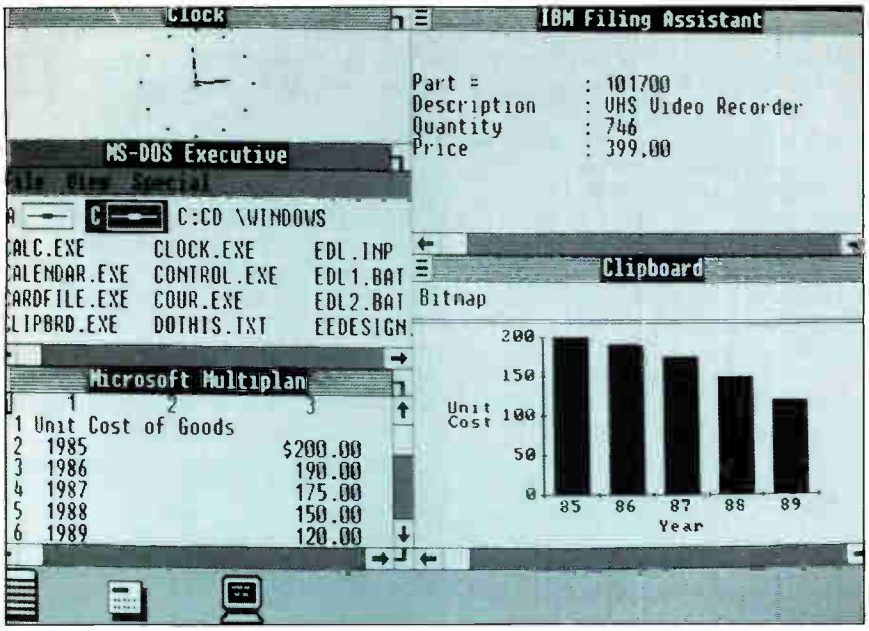
GUY KAWASAKI
Manager of software products, Apple Computer Inc.

"A year ago, everyone was predicting that there'd be a great shakeout, there would only be five companies left. That's not happening. Admittedly, it's tough to be a $20 million company today, but it's very easy to be a $1 million to $2 million company that advertises in very small and inexpensive journals and goes to very small and inexpensive trade shows. It's better that there be fifty $2 million companies writing Apple software than one $100 million company."

ESTHER DYSON
Editor and publisher, Release 1.0 *newsletter*

"A lot of deadwood is going to die, and there are always going to be new folks with new ideas, most of whom will probably not even find their own marketplace. You're going to see the impact of [Microsoft's] Windows and multitasking. There will be less necessity to stuff everything into a single application, and you'll go for appropriate integration and cooperation."

Another area to watch: "The integration of what is now called desktop publishing into what the word-processing companies are offering, thereby snatching the market away from a lot of these new guys."



1. INTEGRATION. Microsoft's new program, Windows, lets microcomputer users work with multiple applications simultaneously on a single screen.

changes. Beyond that, Lotus is looking at spread-spectrum technology, which offers potentially more reliable transmission. Lotus's data-delivery offerings are currently confined to financial products, but the technology is applicable to other information markets, according to information center group manager Alexander Crosett III.

Emerging new delivery technologies will likely have a big impact on the way software users acquire data. Right now, on-line data-base systems are the leading data providers. But per-use fees and time charges make these systems costly to use. "One of the things we're doing is to try to take a real good slice at some technologies that provide low-cost per [unit] to large amounts of data," says Crosett. "The trend is moving the data down, either to a local-area-network server or to the Personal Computer user's desk, at a fixed cost."

At Microsoft Corp., Redmond, Wash., Windows is being heralded as the first in a new generation of software (Fig. 1). Windows allows users to work simultaneously with multiple applications programs. Thus one section of a screen might be filled with a spreadsheet, another could hold a word-processing file, and a graphics application could run in a third area. Well over 100,000 units have been shipped since the software's introduction last fall.

Standards are needed for networking to hit its stride

The integration of text and graphics is a key feature of Windows. Applications are coming that will work with specialized graphics chips, such as Texas Instruments Inc.'s new 30410, that are finding a home in personal computers. Most important is the high level of data exchange between applications that Windows supports. Data exchange is facilitated by sharable run-time libraries or subroutine-like software contained in the program, according to Windows marketing manager Paul J. Davis. Because this code can be accessed by the different applications programs, they don't have to duplicate it.

"In the future, Windows applications will share data very freely, so that applications can be created and integrated together from different vendors to suit a particular user's needs," says Davis. Microsoft has dubbed this capability mix-and-match integration.

"When you combine the interactive [text and graphics] component and the data-exchange component, you get what we're working on now," says Davis. The feature, called dynamic updating, will allow what are sometimes referred to as interapplication hot links. Information destined for input into a single Windows application program will be immediately funneled to all other Windows applications. Thus real-time stock quotations received on a personal-computer reception system such as Lotus's Signal could appear simultaneously in separate Windows for graphing, spreadsheet analysis, and report generation. Some dynamic updating features are available in a restricted form in the current version of Windows.

"An area that we think we'll do quite well in is desktop publishing," says Davis. "Previously, that required too much horsepower for a personal computer. And once you had a reasonably powered personal computer, you had to tune all the algorithms to run on one display, to drive one typesetter, [and] to do page layout. With a graphics environment such as Windows, we can push $20,000 typesetting systems down into a $5,000 desktop."

The company is also banking on networking. According to David Melin, Microsoft's product manager for systems software, about 10% of all corporate PC users will be connected on networks by the end of the year (Microsoft's network offering, MS-NET, works with DOS-based microcomputers). Melin believes that, to date, applications software has not fully exploited the use of networks. "Users want to use their existing software with a network. They don't want to have to buy a no-name version of Lotus's 1-2-3 because it runs on their network," he says.

UNSETTLED STANDARDS

MS-NET is the first step toward a fully distributed environment, says product manager for systems software Jon Danskin. Here, Xenix (Microsoft's version of AT&T's Unix operating system) seems to be emerging as a standard. Though Microsoft's MS-DOS is the operating system of choice for single-user personal computers, multitasking, multiuser environments will work with Xenix, he says.

To date, the slow emergence of internetworking standards has held back LAN development. "This thing is never going to explode like people want unless there's some software package that people want on the network," warns Melin. "It's going to be a long, slow pull."

At Ashton-Tate, the main revenue producer is DBase 3. According to Future Computing, 67,204 packages of the software, to run on IBM PCs and compatible machines, were sold during 1985. That helped push earnings last year to $16.6 million on revenue of $121.6 million. The Culver City, Calif., company bills its data-base product as a tool to work with large amounts of information. DBase 3 creates data bases out of user-supplied data and files. These data bases can then be manipulated and analyzed by entering a series of DBase 3 commands; the user, in effect, writes a small computer program.

"In the future, people will need to work with not only the data bases they create themselves but with a whole host of data bases that will be floating around," says Robert Carr, Ashton-Tate's chief scientist. These include data bases stored on compact-disk read-only memories as well as company and departmental data bases residing on network file servers. In addition, Carr believes users will amass an increasing amount of individual data. Memo and report files, electronic mail, and

2. AI MAN. Gerald R. Barber, R&D vice president of Gold Hill Computers, believes expert systems can be developed on the IBM PC AT using Common Lisp.

electronic telephone-management software fall into this category.

"Right now, I think one of the major bottlenecks to the PC is we're asking our users to learn and thereafter rely on the MS-DOS hierarchy of directories to be able to save and find their information, and it's a pain," says Carr. So Ashton-Tate is now exploring new ways to handle and process these up-and-coming data bases.

At the same time, ease of use is always an issue. With powerful data-base software, full-blown training courses are usually needed to get users up to speed. Many inexperienced users have favored simpler packages that require little training to use, such as Software Publishing's PFS:File. "I don't think you can on the one hand achieve great ease of use and on the other have all the depth of power that more advanced users will want," notes Carr.

Natural-language interfaces are causing a buzz in the PC world

Menus have been the first step in increasing user-friendliness; Ashton-Tate has added them into its latest version, DBase 3 Plus. And some data bases, notably Paradox by Ansa Software, Belmont, Calif. [*Electronics*, Oct. 28, 1985, p. 48], now include querying by example, a feature that allows a user to request data by entering a dummy sample of the information sought.

But the most promising solution for users seeking data-base smarts may come through natural-language interfaces. With this setup, a computer can interpret everyday English sentences, obviating the need for specialized commands. Carr believes natural-language interfaces are one to two years away. R:Base 5000, a data-base package from competitor Microrim Inc., Bellevue, Wash., features querying through a natural language called Clout. These interfaces will greatly increase the size of data-base packages. A program such as DBase 3, which occupies about 400-K of memory, would likely double in size. Because of the added processing burden, such a system would run on PC AT-class or higher machines.

Though natural language also has potential in user training, the big item there may be optical memory. Lengthy training courses can easily be accommodated on the 540 megabytes of storage space that the CDROM provides. These courses could soon accompany high-end software products.

"Right now, we have about 200-K of help systems in both DBase 3 and Framework," Ashton-Tate's integrated business software package, says Carr. "I think what's more appropriate would be to have 10 to 20 megabytes of embedded training, kind of like the equivalent of the on-line tutorials that we ship now.... While users are actually using the software, they can get five-minute mini-lessons teaching them the capability they need now in steps."

At the low end of the microcomputer software market, privately owned Software Publishing Corp. has long been a leader. The Mountain View, Calif., company's PFS line of data-base, spreadsheet, word-processing, graphics, and communications packages (dubbed PFS:Plan, PFS:File, PFS:Write, PFS:Graph, and PFS:Access, respectively) have proved to be extremely popular with inexperienced computer users. However, "the need for entry-level-type software is beginning to peak out," according to vice president of research and development John Page. So while keeping the budget PFS line, the company is also attempting to move upscale.

Software Publishing is seeking to sidestep entrenched competition such as Lotus. "Our goal is to try and find a non-confrontational way to get into a higher-priced product line," says Page. With its recent acquisition of Harvard Software Inc., the company has done just that. Its first products, billed as specialty productivity packages, are Harvard Total Project Management and Harvard Presentation Graphics. Aimed at the IBM PC and compatibles, both retail for $495.

The packages, like most general-purpose software products, are sold primarily through retail markets. But Page believes that the software market is now in the process of breaking into two distinct segments.

"Large corporations decide on some core software that they're going to use, like a word processor or Lotus's 1-2-3. All that happens is [the retailer] takes in a copy of 1-2-3 and ships it out the other side, marking it up 100%, and that's no value at all for that customer. So that customer is finding ways to bypass that retailer and the corresponding markup." Consequently, Page believes, core software is disappearing from the retail loop.

SERVING SMALL BUSINESSES

But retail stores will continue to service small businesses that don't have their own computer expertise, he says. Their value will come from the recommendations, training, and support they can provide. In addition, larger companies will continue to purchase accessory software from retailers. "It looks like it might be time for software [only] stores."

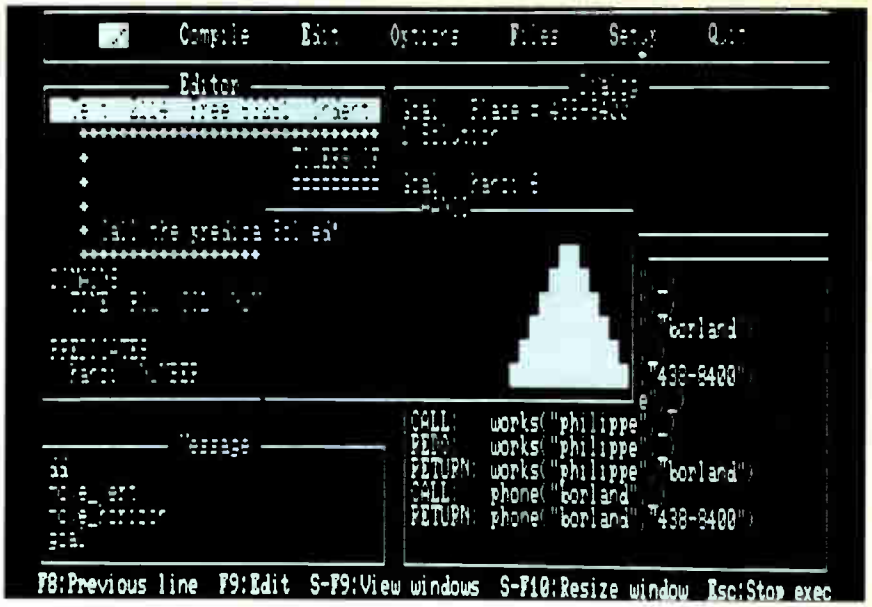
In the future, artificial intelligence is the area to watch. Today, microcomputer software vendors are beginning to jump on the AI bandwagon. Many observers are saying emphatically that AI is *not* a single, well-defined technology. In fact, what constitutes AI is often in the eye of the beholder. So observers suggest taking a close look at new microcomput-

er offerings that claim to incorporate AI concepts.

Gold Hill Computers offers Golden Common Lisp, which is billed as the first Common Lisp programming language developed for the IBM PC. The Cambridge company claims that benchmarks show that their Lisp development package, running on a PC AT, can outperform a Digital Equipment Corp. VAX 11/730 and equal a VAX 11/750 (Fig. 2).

This August, according to Gold Hill vice president for R&D Gerald R. Barber, the company will be able to turn an AT into a Lisp machine. With Common Lisp enhancements, the use of windows, and object-oriented programming, the setup makes a good companion to the more costly AI development systems from Symbolics, Cambridge. "A hundred-rule expert-system application is perfectly feasible on a PC," says Barber.

This August, Gold Hill will also ship an expert-system-development toolkit to supplement the Common Lisp package. In the longer term, the company is targeting personal computers of another sort: Common Lisp will be developed to run on Intel Corp.'s new iPSC personal supercomputer (see story, p. 30).



3. AI PROLOGUE. Borland International's Turbo Prolog is going head to head with Lisp as the AI programming language for the IBM PC.

As the leading AI programming language, Lisp has long been chased by Prolog. On personal computers, though, Prolog is getting a big boost from a new, low-cost package introduced by Borland International Inc. The privately held Scotts Valley, Calif., company recently announced Turbo Prolog, a compiler and development package for that AI programming language (Fig. 3). With the product, Borland founder and president Philippe Kahn is challenging the dominance of Lisp. "I guarantee that with Turbo Prolog you'll see a complete reversal of that tendency—Prolog will become the predominant language of AI, at least on PCs. And as a consequence, it'll happen on mainframes," he predicts. In the future, Kahn says Borland will market expert-system-shell toolboxes and other add-ons, but will not say just when these will be released.

But Kahn will speculate on the future of AI. "I have two theories about AI. The first one is everybody thinks that people who are involved in AI are somehow floating eight feet above the ground. The second thing is that people tend to that think AI is what hasn't been done yet—if it's been done, it's not AI," says Kahn. On that basis, he says that Borland's new Turbo Lightning software is an application of AI. Running on the IBM PC and compatible machines, Turbo Lightning features an automatic spelling checker with a 50,000-word dictionary and a thesaurus. The package is also part of the trend toward microcomputer software that resides in random-access memory: the routine remains in active memory so that it can run simultaneously with such other applications as word processing.

AI is finding its way into a range of packages

Airus Corp., Lake Oswego, Ore., also features a spelling checker in its AI:Typist word-processing program for the IBM PC and compatibles. The program scans a dictionary between each keystroke to find a match. If no match is found, an error is indicated and the word is highlighted on the screen. Airus is now licensing the user-interface portion of AI:Typist to other software developers.

As for the major AI-development-tools companies, Teknowledge Inc., Palo Alto, plans late spring delivery of the IBM PC AT version of its S.1 expert-system development tool. IntelliCorp, Mountain View, plans a PC-host delivery system for its Knowledge Engineering Environment (KEE). The ART tool, from Inference Corp., Los Angeles, was recently announced for the work-station-class IBM RT PC. Pittsburgh's Carnegie Group also plans to offer its Knowledge Craft tool for the RT PC.

Another emerging area may be software for the home. At least Portia Isaacson, founder of the microcomputer forecasting company Future Computing, thinks so. Recently, she started Intellisys Corp. (see story, p. 49) to develop and market software for the electronic house of the future.

RUNNING THE HOUSE

At the company's Richardson, Texas, base, Isaacson's house serves as the showpiece for the technology. "The house is the first completely integrated electronic home," she says. "What we have built is like a prototype. Now we're implementing the software, which will be our production-tailorable version." Many consumer electronics manufacturers are interested in developing interfaces and control software for their products, she notes. Intellisys will also work with software developers and builders and conduct seminars to develop the market for the software.

Also looking to the future with new ventures are three microcomputer industry pioneers: Daniel Bricklin, Gary Kindall, and Lee Felsenstein. Bricklin has been big in the field since 1978, when he came up with the idea to design an electronic spreadsheet for microcomputers (Fig. 4). Early the next year, he founded Software Arts, which was off and running with the VisiCalc spreadsheet.

Today, Bricklin is back in action with a one-man operation called Software Garden. Operating out of his West Newton, Mass., home, he has come up with a new twist in software tools. His product, dubbed Dan Bricklin's Demo Program, allows software developers to rapidly simulate the screens that a real program will generate.

"What people use it for is prototyping products that don't exist yet," he says. The package, which runs on IBM PCs and compatibles, contains a screen painter to design text-oriented displays. A series of stored screens is played back in rapid succession to simulate the prototype in actual operation. To date, customers have included Apple, Ashton-Tate, Cullinet,

Lotus, and Software Publishing, says Bricklin.

Kindall, another microcomputer software pioneer, was chairman of Digital Research Inc. when he developed CP/M, which for a time was the leading microcomputer operating system. Today, Kildall is pioneering another technology with important implications for the microcomputer software industry. Through his Monterey, Calif., company, KnowledgeSet Inc. (formerly Activenture), Kildall is offering software for CDROMs. The digital optical disks [*Electronics*, Sept. 16, 1985, p. 26] store up to 540 megabytes of text and graphics.

Handling the CDROM-based data has been dubbed knowledge processing. "As knowledge processing emerges, there are going to be lots of opportunities to develop software to process all of this data," Kindall says. His company's first product is software to access and manipulate CDROM data bases, called the Knowledge Retrieval System (KRS). The software works in conjunction with the CDROM version of Grolier's Academic American Encyclopedia. Upcoming from Kildall is Knowledge Writer, an accessory program that lets users do word processing of data extracted from CDROMs.

As an emerging medium, CDROM will reach a critical mass within the next year or two, according to Kindall. "I think that during the remainder of this year, we're going to see a lot of R&D projects. We see a lot of startup work with publishers being done in the middle of the year. The first part of next year, that's going to wrap up, and the tail end of next year I think we're going to see some real activity," including releases of a host of CDROM legal, medical, and financial data bases.

Hardware engineer Felsenstein, the designer of the legendary Osborne 1 portable computer, is also back in the microcomputer game. This time, one of his efforts involves software.

Felsenstein's Berkeley, Calif., Golemics Inc. is offering Sequitur, a relational data-base-management system. The software was designed in the late 1970s as part of the attempt by the Berkeley Community Memory Project to develop street-corner information terminals for public use. Running on IBM PCs and systems based on AT&T Bell Laboratories' Unix operating system, Sequitur has a higher degree of relationality than other data bases, says Felsenstein. Relationality means the system offers greater flexibility in manipulating data. Sequitur can handle tables up to 975 columns wide, with variable field lengths. It features query-by-example searching.

With so much software development centered on the IBM PC, whither Apple? "I guess it depends on how you want to look at the world," according to Guy Kawasaki, Apple's manager of software products. "If we are the second standard for software developers to program on, I think that's an acceptable position." When the Macintosh was released, it was criticized for a lack of software, says Kawasaki. "Now that there's software, they're saying, 'Nobody's doing anything more.'"

4. BRICKLIN'S BACK. Spreadsheet pioneer Daniel S. Bricklin has started Software Garden.

ALL THAT JAZZ

Current major software offerings for Apple's Macintosh include Lotus's spreadsheet Jazz as well as packages from Microsoft: Excel, Word, and Multiplan, and the Basic and Fortran programming languages. Ashton-Tate is reportedly readying a spreadsheet package. Software Publishing Corp. says it has no plans to develop software for the Macintosh.

"Within the next year or two, you'll see very significant revisions to current products from our software developers," adds Kawasaki. The Macintosh, he says, is making significant inroads both in desktop publishing and in the engineering marketplace. "Following this trend, there is an infinite number of engineering-software companies that are shipping circuit-design software, instrumentation simulation, pc-board design software. I believe for the next year the growth will be an infinite number of niche markets."

In the longer term, industry observers generally agree that the success of the Macintosh depends on Apple's continued efforts to open up its architecture. (An open-architecture microcomputer contains expansion slots for connecting accessories and options manufactured by third parties.) It has been widely reported that Apple has an open-architecture Mac in the works.

Kawasaki would not confirm work on an open Mac, but he did define the attributes of such a hypothetical machine. "Open architecture means coprocessing, it means more RAM, it means an internal hard disk on a card." All those things, he noted, are being offered by third-party developers for users with the closed Macintosh architecture.

As Apple's Macintosh and IBM's PC progress, predicting what software will move along with them will not be easy. The problem is that it will take more than just good technology to survive. To stand out among the myriad new offerings, an individual product will need good marketing behind it.

As Daniel Bricklin notes, most software packages are not quick off the mark, but build their sales up slowly. "I think each product has its own appropriate size and type of organization. The problem is that if you have an enormous hit, you can't predicate your business on running every product the same way. So what companies are learning to do is how to have a mix of products."

According to Intellisys' Isaacson, "It's very difficult to get the attention of a buyer of a software package these days because there are no intermediate distribution channels that are working for software. The computer retail channel is what one would call an unmitigated disaster right now."

Many observers believe that much of Borland's success comes from a unique sales philosophy that runs counter to the trend toward high-priced microcomputer software. "We're more interested in selling a lot of copies at a lower price and less at a higher price—your end result is almost the same in terms of profit," says Kahn. Of the company's selection of 12 products, no single package is responsible for more than 18% of its revenue.

"The problem is that small software companies can have great products and they don't have distribution channels. That's what valuable," says Esther Dyson, editor and publisher of the newsletter *Release 1.0*. One route around the distribution roadblock is to seek out a specialized market. These may lack glamour, "but they can make a lot more money, it's just people don't notice them. Go to a trade show of shoe retailers and you bet there's a shoe retailer package or two that everybody knows about, or there should be."

Yet microcomputer software may itself vanish from the industry's lexicon one day. Says Dyson, "PC software is going to become a misnomer anyway, because it's going to be the end-user component of software that may also reside on the mainframe or a network server." □

VECTOR PROCESSING BOOSTS HYPERCUBE'S PERFORMANCE

INTEL'S iPSC-VX MATCHES CRAY SPEEDS AT ONE TENTH THE COST

Intel Corp. joined the race to build smaller, more powerful supercomputers in 1985 with its iPSC (for Intel Personal Supercomputer), a low-priced, microprocessor-based line of parallel-processing machines in the supercomputer class. Now the company is adding vector processors—one for each node—boosting the iPSC's performance two orders of magnitude. The initial iPSC machines achieve performance in the range of 2 million to 8 million floating-point operations/s. The new iPSC-VX series provides up to 424 megaflops in a 64-bit double-precision operation.

"It's a generation ahead of today's computers in price/performance," says Paul Wiley, marketing manager at Intel Scientific Computers, Beaverton, Ore., which designed the iPSC-VX. It offers supercomputer performance at one tenth the price of an equivalent machine, such as the Cray Research Inc. X-MP, Wiley claims. The top-of-the-line iPSC-VX/d6, for example, costs $850,000 (table); a Cray machine of comparable speed sells for $8 million to $10 million.

Intel believes the iPSC-VX's price will help it move into industrial applications as well as into scientific and laboratory work. To further aid this migration, Intel designed the machine with an easily expandable architecture and a set of software tools and utilities based on Fortran that are optimized for vector processing.

The iPSC machines are based on the Hypercube architecture developed at the California Institute of Technology. In this multiprocessor scheme, each processor is connected to every other processor, making it a parallel system. Intel calls the iPSC's parallel architecture a concurrent system. Traditional supercomputers package raw computing horsepower in single- or dual-processor configurations. Parallel architectures such as the Hypercube are the latest competitors to these old-line machines. Their hardware can be expanded easily for added power, but developing optimized applications software is vastly more complex [*Electronics*, March 10, 1986, p. 44].

Each iPSC-VX node consists of a node-processor board and a vector-processor board (Fig. 1). Multiple high-speed communications channels connect the nodes to each other. Each processor also connects to the system's host processor, or cube manager. The cube manager is an Intel 80286/310 microcomputer running under the Xenix operating system. It has access to a 3-megabyte memory, 140-megabyte Winchester disk drive, 320-K floppy-disk drive, and a 45-megabyte tape drive.

Each node processor is mounted on a 9-by-11-in. printed-circuit board containing an Intel 80286 central processing unit, an 80287 floating-point arithmetic coprocessor, 512-K of dynamic random-access memory, and 64-K of read-only memory. A small message-based operating system called MBOS controls the node processor, and the two are chiefly responsible for coordinating message traffic into and out of the node, for scheduling and executing user processes, and for controlling the companion vector processor.

The vector processor is a highly optimized arithmetic processing unit (Fig. 2). The vector-processor board, which Intel developed jointly with Sky Computers Inc., Lowell, Mass., contains a floating-point arithmetic unit, a data unit, and a control unit. It is designed with a synchronous microprogrammed architecture and has a 100-ns cycle time.

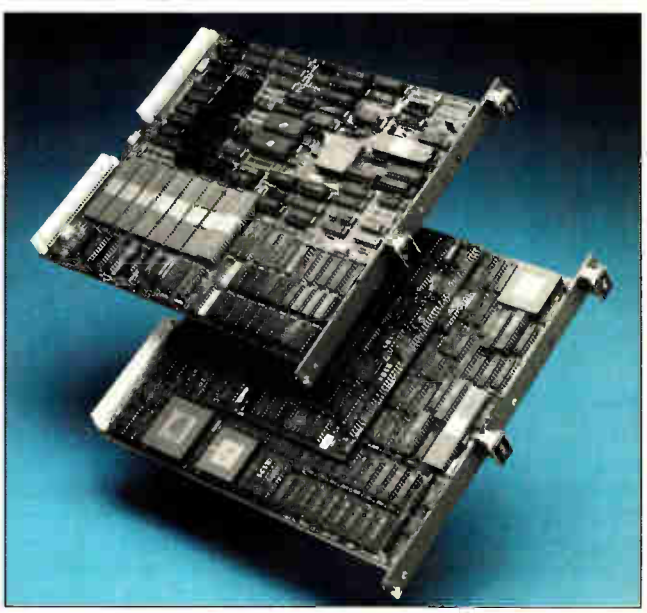
ARITHMETIC FUNCTIONS

The floating-point arithmetic unit, which consists of an adder and a multiplier, operates as a pipelined processor. The adder is implemented with an Analog Devices Inc. 3220 floating-point arithmetic logic unit, which performs 32- and 64-bit calculations. The multiplier is an Analog Devices 3210 floating-point multiplier chip, which can perform 10 million 32-bit floating-point multiplications/s or 3.3 million 64-bit multiplications/s. The unit's 12 registers store intermediate results and stage data into the arithmetic elements. Floating-point operations conform to the IEEE-754 floating-point standard. Also supported are 32-bit fixed-point and logical operations.

With hardware optimized for performing matrix multiplication and addition, the data unit contains a 32-bit address ALU with 1 megabyte of local RAM for vector data, where computational operands are stored. Access time for 64-bit words is 250 ns.

iPSC-VX PERFORMANCE SUMMARY

Features	iPSC-VX/d4	iPSC-VX/d5	iPSC-VX/d6
Nodes	16	32	64
Memory (megabytes)	24	48	96
32-bit peak performance (megaflops)	320	640	1,280
64-bit peak performance (megaflops)	106	212	424
Price	$250,000	$450,000	$850,000



TECHNOLOGY TO WATCH *is a regular feature of* Electronics *that provides readers with exclusive, in-depth reports on important technical innovations from companies around the world. It covers significant technology, processes, and developments incorporated in major new products.*

1. NODAL PAIRS. Each node consists of an 80286-based node processor board (top) and a vector-processing board.

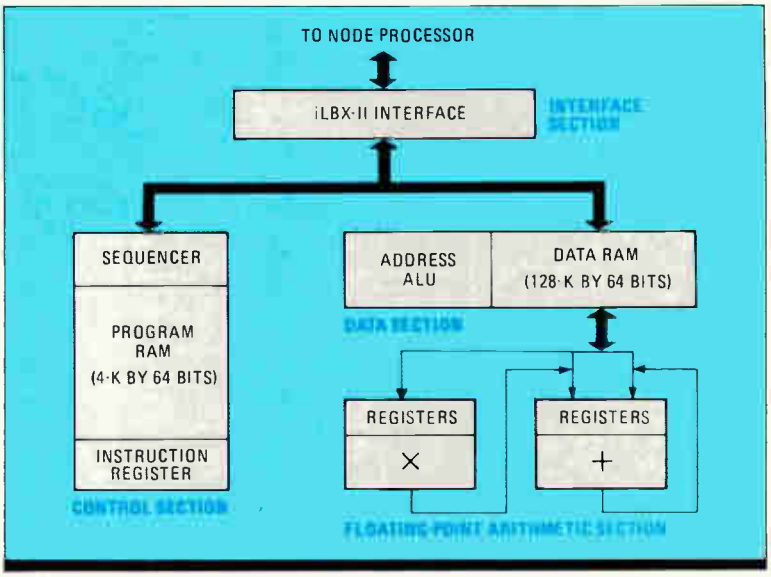
This memory is supplemented by 16-K of static RAM, which has a 100-ns access time for 64-bit words. This fast RAM serves as temporary, or scratchpad, memory; it can improve execution time significantly. Using fast data RAM, the vector-processor board can reach a peak performance of 6.67 megaflops with 64-bit words and 20 megaflops with 32-bit words.

Local RAM is also mapped into the address space of the node processor, increasing the total memory capacity of each node to 1.5 megabytes. Though computation operands are restricted to the vector processor's local RAM, the full 1.5 megabytes can be used to store programs and data.

The control unit contains 32-K of program RAM that can be loaded from the 80286 node CPU. Program RAM holds instructions for the control unit's microsequencer that allow it to coordinate the operation of the data unit and the floating-point arithmetic unit. Microcoded routines include a run-time monitor and Veclib, an optimized library of vector, scalar, and logical operations.

For efficient internode communications, each node processor board holds an 82586 local-network coprocessor that controls seven point-to-point bidirectional communications channels. Six channels connect a node to its nearest neighboring nodes, and one Ethernet channel connects to the cube manager. An eighth channel is reserved for future expansion. The six nearest-neighbor links provide integrated direct memory access between communicating nodes.

The system's global communications channel is controlled by an iSBC 186/51 high-speed communications board. The entire iPSC machine can also be linked to a mainframe or superminicomputer by adding an Ethernet Transmission Control Protocol/Internet Protocol option.



2. NUMBER CRUNCHER. The vector processor is a highly optimized arithmetic processing unit that performs complex mathematical functions.

SOFTWARE SMARTS

The iPSC-VX's software developers appropriated the iPSC's set of software development tools and utilities, based on Fortran, the most commonly used language in supercomputing. Intel offers its Fortran 286 version, but Microsoft Corp.'s 286 assembler is also available, and other languages will be offered in the future. The iPSC-VX program-development package contains development tools, an optimizing Fortran compiler, a Fortran vectorizing preprocessor, a simulator, a microcode development toolkit, and the Veclib math-function library.

Parallelism is the key to the development of software that exploits the iPSC-VX's processing power. To execute most effectively on parallel computers, programs must be divided into separate portions that can execute on the individual nodes. Writing this software is a challenge for programmers because most often it's not readily apparent how to break up, or decompose, a program.

To automate this process, Intel developed a vectorizing preprocessor called VXP. Using a standard Fortran 77 program, VXP extracts the computational portions of the program and partitions them for routing to the vector processor. This is done by substituting vector operations for vectorizable code segments: mathematical statements and routines in the original source code are replaced by directives that call on the vector processor.

Also assisting in vector processing is the Veclib library of microcoded mathematical functions. Veclib contains some 100 routines, invoked through Fortran subroutine calls, for performing optimized scalar, vector, and matrix operations. Microcode development tools are available as an option to allow users to add customized routines to Veclib.

Intel is targeting scientific end-users for the iPSC-VX, but it also believes computer scientists will make it their main testbed for conducting research in parallel computing. Near-term, the company sees a market for the iPSC-VX in such applications as circuit simulation and molecular modeling. □

KEEPING INTEL'S DESIGN IN THE FAMILY

Hardware designer Tom Roth, software developer Roger Golliver, and marketing manager Paul Wiley all helped create Intel Scientific Computers' iPSC family of concurrent computers in 1985. The same team was called on to add vector processing, creating the iPSC-VX.

Roth helped design the iPSC-VX as a tightly coupled system of enhancements and upgrades. He is a seven-year veteran of Intel and was the third person to join the Beaverton, Ore., operation in 1984. He received his BS in applied science and engineering from Portland State University in 1977.

Golliver managed the vector-coprocessor software-integration project. On the original iPSC system, he was responsible for the detailed design and implementation of communications software. Prior to joining Intel Scientific Computers, he worked at Aptec Computer Systems Inc. He earned a BS in mathematics from Michigan State University in 1979 and an MS in computer science from the University of Michigan in 1982.

Wiley, marketing manager for numeric computing at Intel Scientific Computers, was the driving force behind the development of the VX enhancement. Before joining the group in June 1984, he spent six years at Floating Point Systems Inc. and eight years with Interstate Electronics Corp., a defense contractor. He earned a BSEE from Virginia Polytechnic Institute and an MS in electronic communications from California State University at Fullerton.

TOP THREE. Intel's Roth, Golliver, and Wiley added vector processing to the iPSC line they created.

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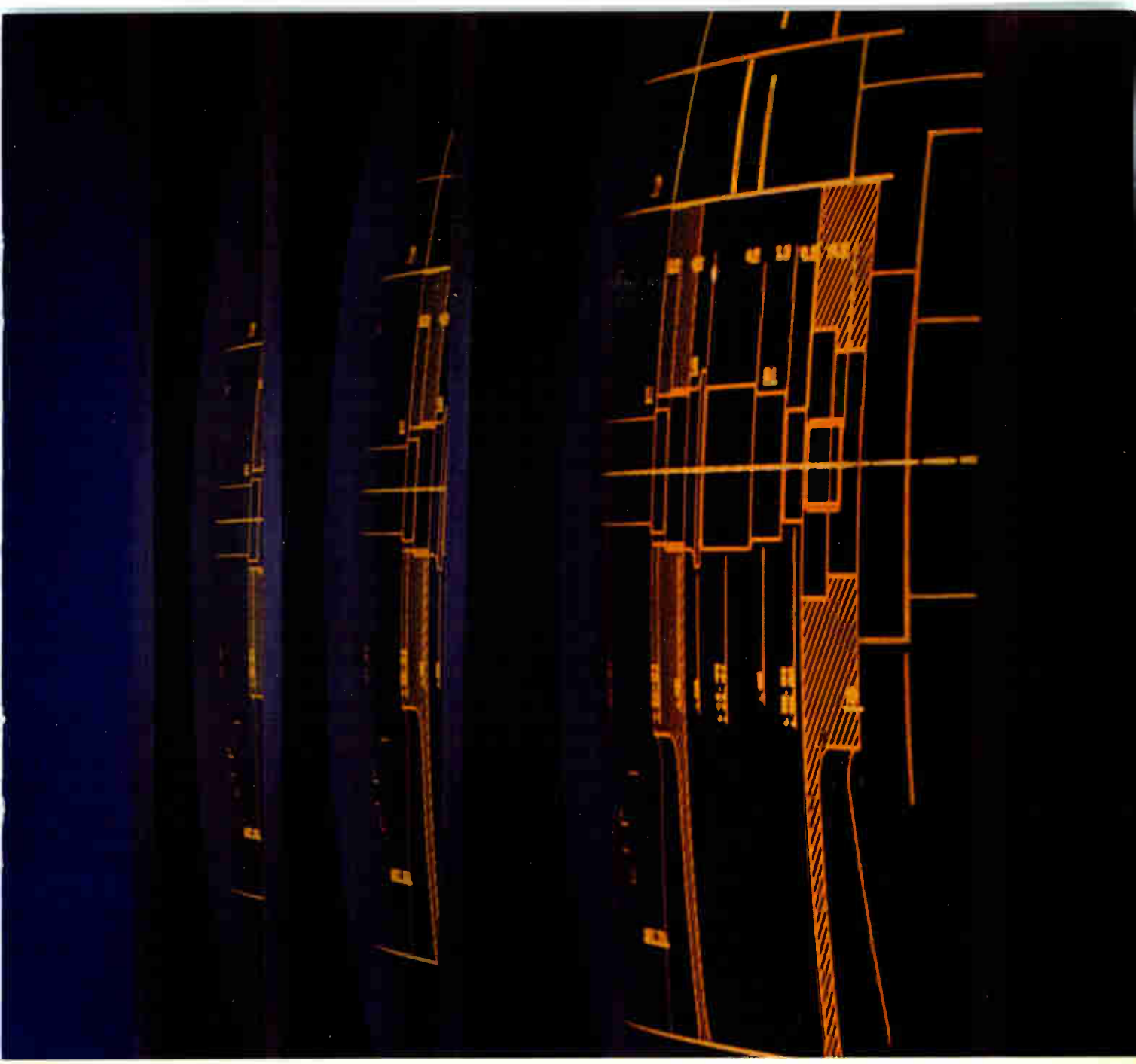

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TANDEM MAKES A GOOD THING BETTER

ITS FIRST MAINFRAME RUNS TWICE AS FAST

In the competitive world of computer technology, a company is only as good as its latest design. And on that benchmark, Tandem Computers Inc. gets high marks with its first mainframe-class machine, the NonStop VLX. The new model not only lops 30% off the per-transaction cost of the two-year-old NonStop TXP superminicomputer, but it also rests on a hardware base that is three times more reliable, the company says (see related story, p. 39).

Designed for heavy-duty on-line transaction processing in such areas as airline reservations, banking, computer-integrated manufacturing, and telecommunications switching, the NonStop VLX executes 12 million to 48 million instructions per second. The Cupertino, Calif., company says that's roughly twice the performance of the TXP for about the same price. It attributes the higher price/performance ratio and reliability primarily to the extensive use of the MCA2800ALS, an emitter-coupled-logic gate array that serves as a building block in critical parts of the central processing unit (see "Easy-design features make macrocell a hit," p. 35). Other performance hikes come from streamlined instruction execution, reorganized cache memory, and a faster interprocessor bus.

Although speed was the paramount concern in designing the VLX, its developers also concentrated on fault tolerance and compatibility with the previous-generation system. The NonStop configuration of both the TXP and VLX provides dual paths to every element in the system. If one path fails, a second is available to make the connection. If one processor fails, another assumes its workload. Although this duplication slows throughput to a small extent, it guarantees that failures will not affect system operation.

When all units are functioning, they carry their full share of the processing load—there are no idle spares. This fault-tolerant architecture, which remains unchanged on the new VLX system, can be described as a loosely coupled parallel-processing system with distributed, nonshared memory.

One benefit of the distributed processing architecture is that it does not require one large central processor running at the highest possible clock speed. "Our design was at a point where we needed a faster central processor—but not the fastest possible," says Al McBride, Tandem's technology director. "We could get higher total system performance from the parallelism of the system architecture."

The parallel architecture allows Tandem to be more conservative in processor design than manufacturers of high-speed CPUs. For example, the company limited the number of circuits implemented on a gate array to 2,000 out of the 2,800 available gates. This meant that the macrocell arrays were easier to design and yielded a more reliable system.

The minimum VLX system consists of four CPUs, but the architecture can accommodate as many as 16. Thanks to the macrocell technology it developed jointly with Motorola Inc., Tandem was able to implement a two-board processor that executes 3 mips. By comparison, the TXP's 1.5-mips CPU fit on four printed-circuit boards using medium-scale-integration TTL chips.

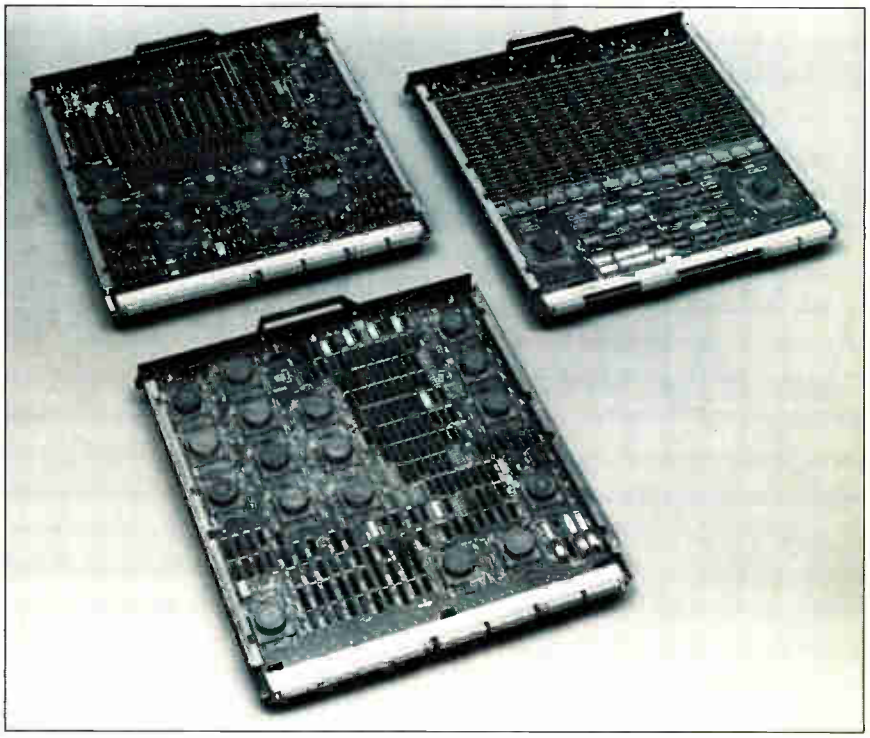
The denser macrocell array chips allowed each VLX processor board to contain about three times as many gates. Much of the VLX's speed improvement came from packing more logic onto fewer chips and boards, which reduces the number of interchip and interboard signals.

CIRCUITS TO SPARE

"We went from approximately 53,000 gates on four logic boards to approximately 85,000 on two," says John Beirne, engineering manager for VLX hardware development. "The macrocell arrays allow up to 2,800 circuits per array. But 2,000 to 2,300 is a more reasonable count for this circuit."

The mainframe's CPU holds 21 types of custom macrocell arrays (Fig. 1). In total, there are 33 different macrocell arrays in the Tandem two-board processor set. Of these, 31 are on the two logic boards that make up the CPU and two are on the accompanying memory boards. These include clever macrocell array designs that speed instruction execution from cache and branch operations.

Two critical elements of the new CPU that improve its overall speed in these areas are the instruction unit and execution unit (Fig. 2). The instruction unit consists of 10 macrocell arrays. One is a chip that makes a four-stage pipeline for simultaneously processing four instructions obtained from the



1. ARRAYS ABOUND. The 31 gate arrays in the CPU's two boards (left) make high-density logic circuitry. Two arrays and 256-K chips populate the 8-megabyte memory board (right).

64-K static-random-access-memory cache. The processor can fetch one instruction, decode a second, preprocess a third, and execute a fourth.

Two more macrocell arrays build a displacement adder that does address arithmetic for prefetching operands. This unit adds a displacement number to a virtual address to determine its physical address on a board. When the instruction unit prefetches instructions, address processing occurs in parallel with execution to anticipate the next instruction address.

In the older TXP, microcode-carried-out address calculation used discrete logic chips. In both systems, the processor instruction set holds 220 machine instructions that handle such jobs as stack operations, integer and decimal arithmetic, and byte-oriented functions. In addition, 43 other instructions perform scientific calculations.

The instruction set is implemented by microinstructions in the control store, which users can use to implement new instructions or improve existing ones. Two of the 10 instruction-unit macrocells handle addressing of the control store.

Another macrocell array in the CPU is dedicated to branch control. It examines the conditions of all branch (or jump) instructions being executed. If the conditions indicate a jump, the array helps determine the next address to be accessed. This look-ahead capability tests the jump condition prior to execution of the jump instruction. By knowing that a jump is imminent, the contents of the cache can be flushed and reloaded with the contents of the new jump address and the subsequent addresses in this new sequence of instructions. Anticipating the jump can shave microseconds off an operation.

Four macrocell arrays in the address-translation unit cut the cache-fill time in half when the cache must be flushed and reloaded, as when a jump is executed. Tandem says this alone contributes several percentage points to the performance improvement of the new-generation system.

The cache itself got a speed boost. Cache cuts the time required to access data and instructions from slower main memory. During operation, several instructions following the one being executed have been prefetched into the cache. For example, when there is a program in memory that the computer needs to execute, the processor fetches the program instructions from the high-speed cache instead of directly from main memory, thus reducing the amount of time to get an instruction. Besides being slower than cache memory, main memory is located off the processor board, which delays fetches from it even more.

New cache-hashing algorithms ensure a higher number of cache hits—that is, that needed instructions are in cache rather than in main memory. "Improving the performance of the

EASY-DESIGN FEATURES MAKE MACROCELL A HIT

The best-seller in Motorola Semiconductor Products Inc.'s cell library is the MCA2800-ALS. The emitter-coupled-logic macrocell array, the product of a joint development effort between the Phoenix, Ariz., Motorola Inc. subsidiary and Tandem Computers Inc., is a critical component in Tandem's fault-tolerant VLX NonStop computer.

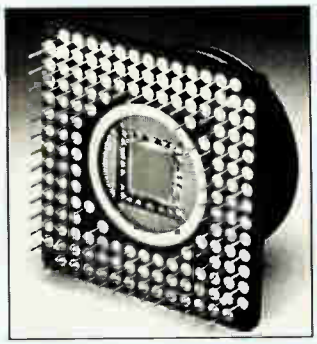
Built with an advanced process called Mosaic II (Motorola oxide-isolated, self-aligned integrated circuits), the array outperforms discrete 100K ECL chips. With a single 5-V power supply, it runs at 125 MHz with a typical 600-ps gate delay.

Mosaic II is a bipolar process that uses oxide isolation, which produces much smaller transistors than junction isolation. Some of the MCA-2800ALS speed improvement results from compressing the 2,000 or so gates down to an area no larger than 100 mils^2.

"One significant contribution Tandem made to the macrocell array is making it easier to design with," says John Carey, Motorola's merchandising manager. An especially attractive feature to logic designers is the TTL input/output capability Tandem added to the macrocell. TTL I/O cells, not found on other any ECL macrocell arrays as yet, make it easy for designers who are adept at using TTL logic to incorporate the device into their designs. There are 120 signal pins on the chip, hence 120 TTL I/O cells. Each I/O cell is tied to a bonding wire coming off the chip and can be an input or output buffer.

With the array, a designer does not have to learn new design techniques to create his final design on the chip because the library of macro functions is very similar to existing discrete TTL circuits. Using a gate array with TTL I/O pins affords other benefits as well. For example, the designer does not have to use controlled-impedance boards, a must for ECL designs.

All 120 I/O cells can be used. "It is one of the more dense I/O structures on the market," says Carey. "There are no restrictions concerning which pins can be an input, output, or bidirectional. Any one can be an input, output, or a tristate [high-impedance state] cell." Most arrays impose restrictions on which pins can be used.



BEST SELLER. The MCA2800-ALS comes in a pin-grid array with a heat sink on the back.

The I/O cell is a significant addition to the Motorola library, but Tandem didn't stop there. The Cupertino, Calif., company changed the components making up the macrocell, which made it possible to implement a circuit element, such as a flip-flop, more efficiently. Tandem also improved the implementation of plain NOR and NAND gates inside the macrocell. These gates constitute about 20% to 25% of a chip's real estate. By implementing the NOR gates more effectively, for example, the designers achieved a 20% chip-density improvement.

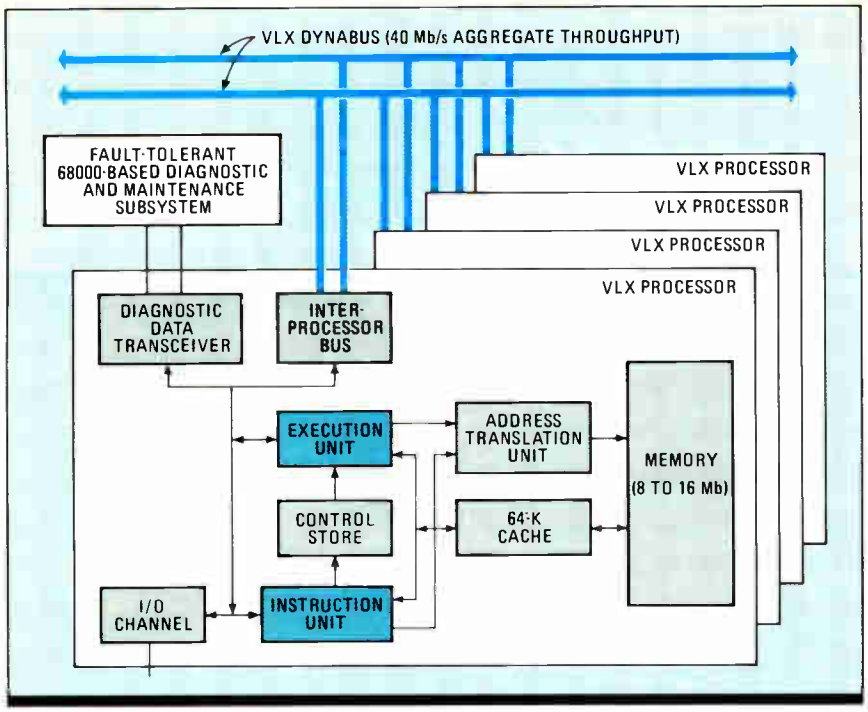
For its NonStop mainframe, "we changed the distribution of the types of resistors and transistors in the macrocell," says Al McBride, Tandem's technology director. "We made changes to both the simple and complex functions to make sure we used a large percentage of the 2,800 circuits on each array."

Tandem also trimmed the power consumed by individual gates by changing the output resistor's rating. ECL internal structures have an emitter-output follower circuit. The output signal is dropped across the emitter resistor.

A variety of values are possible with this resistor. If the cell is used in a relatively low-speed data path, for example, a designer can reduce the power of the circuits in this path to reduce system power consumption.

"We changed the operating point of the current gates in the chip's internal ECL," says McBride. Very high-performance ECL products dissipate more than 8 W. Tandem needed to have no more than 5 W in worst case. "We changed the output-switch operating current. As current flow is lowered, the performance, is necessarily decreased. The output-switch operating current is a value we traded off to reach our design goal," McBride explains. The tradeoff gave Tandem the necessary system performance without having to use liquid cooling.

Tandem and Motorola also created a three-level ceramic pin-grid-array package that has heat sinks. This further improves reliability of the chip. Reducing the operating point by 10° to 15°C doubles the chip's life.



2. BASIC SET. A starter VLX system contains four identical CPUs, each with one or two memory boards, tied together by the Dynabus. A system can be expanded to 16 processors.

cache-hashing algorithms [the way cache is organized for quick retrieval] is an important means of getting the hit rate up," says Beirne. "We took benchmarks on our early designs and tried various hashing algorithms. By running the benchmarks in a simulator to determine hit rates early in the design process, we knew what kind of performance we were going to get with the architecture."

Like the displacement adder, the address-translation unit converts virtual addresses to physical addresses. There are two identical arrays on the memory board for moving 64-bit data words (8 bytes wide) to and from memory. Two macrocell arrays located between memory and cache provide error-correction codes.

The loadable control store, which contains the microinstructions that tell the instruction unit how to execute its instruction set, been made even faster with a dual interleaved design. It consists of fast SRAM that supplies microinstruction words to both the execution and instruction units.

Two more arrays control the addressing of microinstructions in the control store and four chips receive the output of the control store and put it into the three-stage pipeline of microinstructions. The four chips are identical, each one fourth of a total data flow path to the logic that executes the instructions.

TWIN MICROINSTRUCTION BANKS

In the control store is a unique design feature that contributes significantly to improving the operating speed of the macrocell arrays in the instruction unit. It consists of two separate banks of SRAM, each containing identical copies of the microinstructions.

A conventional interleaving scheme divides the microinstructions into two halves, even-address microinstructions in one bank and odd-address ones in the other. The state machine—or instruction unit, in this system—would execute one microinstruction from bank A, the next from bank B, the third from bank A, and so on, because the cycle time of the instruction unit is faster than the RAM access time.

In Tandem's implementation, the instruction unit fetches a microinstruction from bank A, and as it executes, fetches the next microinstruction from bank B. One reason for this approach is that microinstructions are of variable length. Thus microinstruction A may be 1 cycle long and microinstruction B could be 3 cycles long. Having duplicate copies of the same microinstructions in each bank affords the most amount of overlap between microinstruction fetches, hence allowing a greater increase in speed over the conventional interleaving.

A fallout of the duplicated banks of microinstruction store is increased reliability, because a soft error in one bank can be repaired by loading the suspect bank with the known-good bank. In addition, if one of the two banks has a hard failure, the processor can continue operating—but at slower speed—using only one bank.

The company had to use the same instruction set as in its previous-generation systems, but it had some flexibility and freedom in improving the microinstructions used to realize the macroinstructions, or common machine instructions. Tandem's NonStop system instructions can require from one to five microinstructions. Reducing the number of microinstructions needed for one instruction required some additional logic. But Tandem decided that the increased performance resulting from faster execution of instructions was significant enough to warrant the extra logic.

"From what our early benchmarks told us about our existing computer architecture, we discovered which instructions to optimize," says Beirne. "We plotted histograms of instruction usage to see how much time it requires to execute each instruction. Looking at instructions that were executed the most told us where to look for the greatest savings in instruction-execution time. From this data we were able to perform analysis which would tell us we would get so much improvement in performance by adding logic to improve instruction-execution performance. We made the changes, then reran the simulations to see that the benchmarks improved."

OLD BUS, NEW PROTOCOL

Another increase in speed is provided by using a new bus protocol on the existing Dynabus. The previous bus protocol had radial clock distribution, which requires costly cabling. The new protocol uses a double-clocking scheme in which the clocks are distributed with the data. This method automatically reduces the amount of skew between the clock and data, thus allowing the system to more tightly compress the interval of data transmission.

The clock and data slow down the same amount over a longer length—if the data arrives later, so does the clock. Once transmission begins, the interval between data bursts can be very tight.

The new protocol allows Tandem to extend the length of the bus as well as increase its speed from 13 to 20 megabytes/s per bus. With two buses in the system, the aggregate bus transfer rate went from 26 to 40 megabytes/s. "We have not seen a case where bus speed is a bottleneck," says Beirne. "However, we feel that the improvement positions us well for future processors as well as allowing heavier loading on the VLX processor. It gives us more margin."

When the system is operating, packets of transaction information move to and from the CPU through its I/O channel and the Dynabus. A high-speed bus on the CPU connects the Dynabus, I/O channel, and diagnostic data transceiver (a mi-

croprocessor that automatically monitors the CPU) with the execution and instruction units. Packets enter a one-packet-wide input queue in the Dynabus, diagnostic data transceiver, or I/O channel, depending on which is active, and their arrival generates an interrupt flag to the instruction unit. The interrupt causes the instruction unit to begin processing the packet. During this time, the processor's instruction unit begins fetching instructions from memory to determine what kind of processing the incoming packet requires. The incoming packet enters the execution unit when the program running in the instruction unit executes a Receive instruction.

ONE MACROCELL PER BUS

On the Dynabus board are two macrocell arrays that execute a sequence of prescribed instructions for receiving data off the bus. There is one macrocell array for each part of the dual bus. These chips receive data from the bus, check it, and pass it into the one-packet-wide input queue on the Dynabus. Previously, discrete logic performed this operation by executing microinstructions.

Functional logic that handles packet receipt and transmission is in the same macrocell array that receives and transmits data to and from the bus. Processing occurs much faster because more processing is performed inside the chip, with fewer chip crossings—movements of signals from one logic chip to another on a pc board.

Two macrocell arrays make up the I/O channel and perform a function similar to the Dynabus. The two arrays replace the 70 or so discrete TTL components comprising the earlier system's I/O function. Improved reliability and a reduced chip count were the main benefits of using macrocells in this instance. Improving performance was a secondary consideration because the system was required to remain compatible with existing TXP I/O channels.

The execution unit holds seven macrocell arrays: four arithmetic-logic-unit slices, two register-file slices, and a barrel shifter. The ALU is a slice of the execution data flow path. It includes all the registers, parity-prediction logic, multiplexers, and the data path. Each of the four arrays represents one fourth of a 32-bit-wide ALU, each identical eight-bit-wide units. Each operates on eight bits of the total data word being processed.

The ALU follows the strategy of creating one common macrocell and using it four times, rather than partitioning the ALU function into several distinct functions. The former method reduced the number of unique array designs for the ALU by a fourth. This strategy was used wherever possible throughout the processor and memory boards.

Each two-board CPU can have one or two memory boards, which store 8 megabytes each, for a total of 16 megabytes per

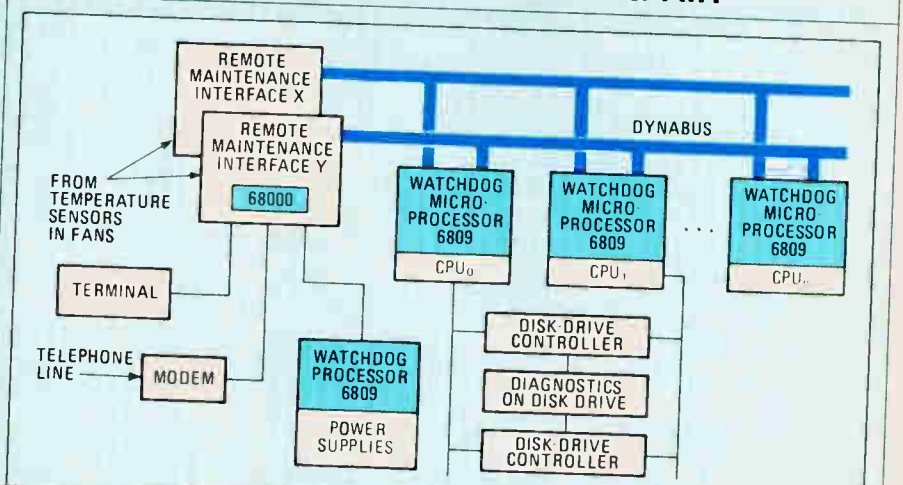
CHANGING COMPUTER FAULT SIMULATION AND REPAIR

The conventional wisdom in fault diagnosis and repair says wait until the problem occurs, then begin. But too often, the fault is a transient failure that cannot be recreated. So in the new NonStop VLX system from Tandem Computers Inc., the TMDS (Tandem Maintenance Diagnostic Subsystem) constantly monitors the system environment: processors, interprocessor bus, and tape subsystem. Microprocessor-based sensors scattered throughout the system can detect a fault as it occurs.

There are microprocessors throughout the system. The two system bus controllers contain the 68000-based remote maintenance interface. Hall-effect sensors inside the fans monitor intake and exhaust temperatures. On power supplies, TMDS can measure the actual analog output level. "These microprocessors collect this information and feed it into the remote maintenance interface and it is then fed back into TMDS, where it is analyzed constantly," says software manager Jamie Allen.

If a fault occurs, say, on one of the main processors, its 6809 microprocessor captures its entire state, 4,000 bits (500 bytes) of information called the event signature, and stores it on disk. It stops the processor clocks within one cycle and captures all the registers and states of the parity checkers throughout the machine. "We do parity checking across the control lines," says Allen.

Expert-system techniques are used to perform the fault analysis. In 90% of the cases, the program isolates problems down to field-repairable units, such as circuit boards and disk-drive modules. Eventually, the TMDS designers expect to achieve 100% accuracy.



WATCHDOGS. Microprocessors scattered around the VLX system gather maintenance data.

There are other fault analyzers in the system. A general-purpose program called the Mother Fault Analyzer is written in Lisp using MRS, a rule-based language that sits on top of Lisp. Developed at Stanford University, MRS is similar to Prolog.

Because it is rule-based, the general-purpose analyzer knows nothing about the events. The program interprets the rules against the event to determine what to do next. It may do nothing, for example, if it reasons that an event is of no importance, such as a corrected soft memory error. The fault analyzer can make some repairs itself.

A user can trace the entire analysis process, including results, at a terminal running a program called Problem Reporter. A Tandem engineer can also perform the analysis over the phone. Remotely, he can perform maintenance operations such as measuring the power-supply voltage, checking the operation of fans, adjusting power-supply margins, and adjusting the clock frequency up or down by 5%.

"We can come in over a modem and perform the analysis and in some cases actually perform the repair, especially if the cure is to rebalance the system, reload a processor that had an intermittent error, or patch a software bug," says Allen.

The remote capability addresses one of the most troublesome parts of the maintenance problem, the "no fault found" service call caused by intermittent faults. With this system, the actual event is captured without having to duplicate the trouble after it has gone. □

processor set. The company points out that memory capacity can be expanded up to 256 megabytes as higher-density megabit RAM chips become available.

Gathering maintenance data has been speeded up, too. Two macrocell arrays inside the diagnostic data transceiver can capture every internal state of the VLX processor board in one clock cycle. Once the data is grabbed, it is shifted serially to a separate maintenance processor. Another macrocell array controls the collection of reliability data. There are eight strings of reliability data collected from each board in the VLX system.

MICROPROCESSOR-MACROCELL INTERACTION

One chip in the diagnostic data transceiver controls all the scanning for data and multiplexes it into a serial bit stream that goes to a 6809 microprocessor on-board the diagnostic transceiver. From the 6809, the information is routed to a separate 68000-based maintenance processor. The second macrocell interfaces the 6809 to the execution and instruction units. "Here is a case where a single microprocessor is used but its related support circuits are put into one custom macrocell array," says Beirne.

Another way macrocell arrays improve processing speed is by allowing the system designer to concentrate on maximizing the performance of circuits that have the greatest impact on the overall system processing speed. Tandem's analysis revealed that about 50% of a computer's operating cycle is spent either in the cache or control store.

Another 20% of the total operating cycle is spent moving data between chips: the output of one logic chip is routed into the next. Gate delays and travel time between chips combine to slow computer performance. Finally, 30% of a computer's operating cycle is spent in the logic of any given chip in a computer design.

Thus in designing VLX, the company spent much of its design effort improving the cache and control store and using high-speed ECL internal chips to speed processing. But they chose to compromise speed for simplified board design in the 20% of the total processor time spent moving data between chips.

Up until recently, ECL macrocells all came with ECL I/O cells. These cells require special interfacing translations if the macrocell I/O is to be connected with TTL circuits. They also require specialized pc boards. All of these requirements conspire to make ECL difficult to design with.

Tandem chose to change the macrocell array so that it offered a TTL I/O cell instead of ECL. "It was a design tradeoff that paid off," says McBride. "We did not have to use controlled-impedance circuit boards, which would be required if using full-ECL gate arrays."

In addition, the company is able to build its boards using many off-the-shelf VLSI and LSI RAMs and microprocessors without having to redesign the entire computer from the ground up. Tandem's designers could have used ECL arrays throughout. But then they would not have been able to use non-ECL VLSI and LSI and the whole processor would have cost more.

A TTL I/O buffer interface on a macrocell chip is slower than ECL I/O buffers typically found on ECL macrocell arrays. "ECL is about two times as fast as TTL, but I/O only affects 20% of the total performance of the computer, so you're talking about only a 10% effect on the total cycle time of the computer," says McBride. In addition, implementing macrocells with ECL I/O could raise the price of the design considerably.

Tandem's design resulted from the fact that they could get enough system performance improvement even using TTL I/O, but TTL I/O allows the chips to be interfaced with all general-purpose commodity parts, RAMs, microprocessors and other non-ECL circuits. It gave Tandem a better system solution in terms of other components on the board as well as the pc-board technology. □

THREE YEARS AND A MILLION DOLLARS LATER...

Tandem's NonStop mainframe project was one program that lived up to its name—technology director Al McBride can attest to that. "My first day, when I entered an empty office, I had $1 million and a note from Jim [James G. Treybig, Tandem's president and chief executive officer] saying turn this into chips," he recalls.

The Cupertino, Calif., company's VLX project began in the fall of 1983 and was fully staffed to meet product requirements by March of the following year. McBride was charged with developing the semiconductor technology.

The first order of business was finding a supplier that could produce high-performance semicustom chips for the VLX, and developing a symbiotic relationship was the key. "When we went into the agreement with Motorola Inc., we were looking at a nine-year marriage. If anything should happen during that time, it could jeopardize our product coming out."

Tandem would help define a new macrocell array, thereby getting the semiconductors it needed. Motorola, in turn, got to sell it as a standard part. "The rationale was simple," McBride says. "When you are a $100 million company and have never bought gate arrays before, and you have a one-man circuit-design department, you make a deal."

McBride worked at IBM Corp. for 15 years before joining Tandem. Since the early 1970s, he has worked on microprocessor and microcomputer chips, some for IBM's Personal Computer.

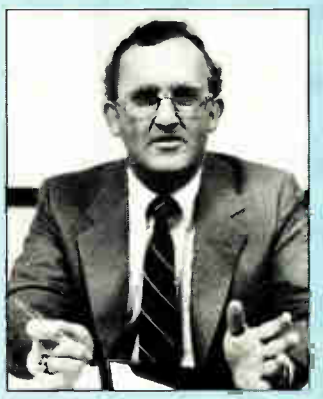
It took about two years to develop the silicon technology, and then the system architects began. "We dovetailed the effort," McBride says. "We developed the silicon technology, and with about a three-month overlap, the system architects began their effort to develop the central processing unit."

That's when hardware manager and fellow IBM alumnus John Beirne took over. "I had two roles: CPU development manager and hardware program manager," he says. "We staffed up a team that designed the macrocell chips for the CPU."

Before coming to Tandem, Beirne, an energetic young man with engineering degree and MBA, spent seven years with IBM. "I was a technical leader and led a software project and worked with advanced chip technologies," he says. "One reason I got on the VLX project was my experience with very large-scale integration."

Though McBride developed the chip technology separately from the actual system, there was considerable interplay. "If we had an idea for a circuit, we could evaluate it within a day or two against what impact it would have on system performance."

JOHN BEIRNE



AL McBRIDE

PROBING THE NEWS

TANDEM'S OLD ARCHITECTURE PAYS OFF IN NEW MARKETS

IS IT A 'THREATENING COMPETITOR' TO IBM IN TRANSACTION PROCESSING?

by Clifford Barney

SUNNYVALE, CALIF.

Tandem Computers Inc. is a true original in a world of look-alikes. Though all computer makers strive mightily for product differentiation, they tend to come up with variations on a very few themes. Tandem has parlayed a unique computer architecture into an almost unmatchable position in the specialized world of transaction processing. The fault-tolerant design is now offering a new payoff: a powerful role in distributed computing and networking, two of the high-growth markets of the 1980s.

"The world is moving toward on-line processing," says Tandem president James G. Treybig. "Businesses are distributed everywhere: branch banks, retail stores, sales offices, point-of-sale operations. If they can understand what is happening instantaneously, they can keep inventories low and provide better services."

The company claims to have 60% of the automatic bank teller market—where it goes head to head with IBM Corp.—and a similar share of the electronic funds-transfer business between banks. Every major oil company uses Tandem equipment for credit-card transactions, Treybig says, and Tandem machines are used in 15 major stock exchanges, including the New York Stock Exchange. And the company is about to sign a contract for total automation of a major U. S. airline. Tandem hopes for even more market penetration with its new NonStop VLX, a cheaper and more reliable successor to its two-year-old NonStop TXP superminicomputer (see related story, p. 34).

Transaction processing will account for $1.8 billion in sales for U. S. computer manufacturers this year, according to a recent report by Frost & Sullivan Inc., the New York market research firm, and will grow to $4.7 billion by 1990. At present, two thirds of the market is from on-line processing, such as automatic teller machines. But office automation, now only 6%, will triple its market share by the end of the decade, and industrial process control will jump from 20% to 25%, the report forecasts. Tandem is even more bullish about the future of on-line processing. Dennis P. McEvoy, vice president of software development, says the market already runs well beyond $10 billion annually, the exact size depending on how the categories are chosen and who is doing the counting.

Last year, Tandem recorded $624.1 million in sales, a sum over 17% higher than fiscal 1984's $532.6 million and a reasonable figure in a miserable year for computer makers. The outlook is tougher this year: first-quarter sales increased only 6.5% over the comparable period in 1985.

"How well we do in 1986 depends on how well the computer market does in the U. S. If it doesn't pick up, we will be hard-pressed to have a better year than last year," Treybig says. International business—mostly to European countries—is strong, he adds, but domestic sales remain soft. "We did relatively well last year," Treybig says. "At least all of our people"—5,500 people at five manufacturing sites, 100 sales offices worldwide, and 19 subsidiary companies—"kept their jobs."

Tandem's architecture is a form of parallel computing. But instead of breaking down one large problem into many small ones, as in most parallel systems, the Tandem approach starts with many small problems and processes them very quickly. Hence its suitability for distributed computing.

TAILOR-MADE. The location of a data base or a peripheral is immaterial in a Tandem system, which makes it well-suited for networking. One process communicates with another through packet-switched messages without regard for physical location. The process of creating a network is therefore straightforward, requiring less input/output buffering than with conventional architectures.

Its ability to offer networks makes Tandem one of the first mainframe manufacturers to be able to challenge networking companies. Through product development, it is already beginning to stress value-added networks, and, with Rockwell International's Switching Division, it has developed an integrated communications and computer system for telemarketing.

Tandem was founded in 1974 to make computers for financial institutions, manufacturers, transportation companies, and others who needed the continuous processing of multiple events rather than batch processing of data. Instead of building hardware redundancy into its system, Tandem designed a message-based architecture, which allows all parts of the system to operate independently. Because the Tandem system can shut down gracefully, nodes can also be added easily. And because all this equipment must be continuously

TREYBIG: 'We are far ahead.'

available to its users, Tandem made it fault-tolerant. As a result, any given fault can be quickly isolated from the rest of the system.

So well has Tandem succeeded in establishing a reputation for fault tolerance that the company's other big strength—expandability—tends to be overlooked in the industry, and Tandem is not generally seen as a leader in technology. Says McEvoy, "If we were a new company and announced the VLX [Tandem's new top-of-the-line product] ... everyone would say that we had outstanding technology. But we didn't start three years ago with venture capital, we started 11 years ago, and people tend to say we have older technology."

EXPANDABLE TO 48 MIPS. The new machine is linearly expandable from 3 million instructions per second to 48 mips, all completely transparent to the user, with no special programming. It can be "put into a distributed network with the same programs, with alternate routing in case of failures," says McEvoy. It boasts state-of-the-art ECL gate arrays and a special disk architecture for parallel throughput, he says.

To compensate for its lack of visibility, Tandem is beginning to take the wraps off some of its technology. With its own semiconductor facility and computer-aided design tools, Tandem worked directly with Motorola Inc. on the design of the ECL gate array for the VLX, thus shaving weeks off turnaround time. This circuit is only the beginning. A CMOS processor is in the wings, and Al McBride, director of very large-scale integration, hints that a new generation of processors awaits only the development of triple-layer metalization for the fabrication of very dense "sea of gates" arrays.

McEvoy claims that Tandem's networking software is also years ahead of the competition. No other distributed data base can run asynchronously and concurrently in multiple memories, he says; Tandem got a jump because it already runs a distributed data base in a single system.

One criticism sometimes leveled at Tandem machines is that the message-based architecture means higher system overhead for users. But McEvoy says that it also results in the lowest cost per transaction and the cheapest route to modular expansion.

"If you stay with a single box," he says, "you are limited to the 20% to 30% performance gain made each year by the technology." With the Tandem system, linking processors results in a near-linear increase in performance, the company maintains.

Tandem's success forced IBM to offer fault-tolerant systems

That's important, says McEvoy, because it gives customers a chance to start small. "You don't always know how successful an on-line application will be," he adds. "Automatic tellers have taken off, videotex hasn't. Modular expandability lets users invest more as demand grows."

McEvoy concedes that Tandem's message-based architecture rules out its participation in the engineering and scientific market and in real-time applications that require microsecond response time. "We are not compute intensive, we are I/O intensive," he says. "You can call it special-purpose computing, but it's applicable to a good third of the business."

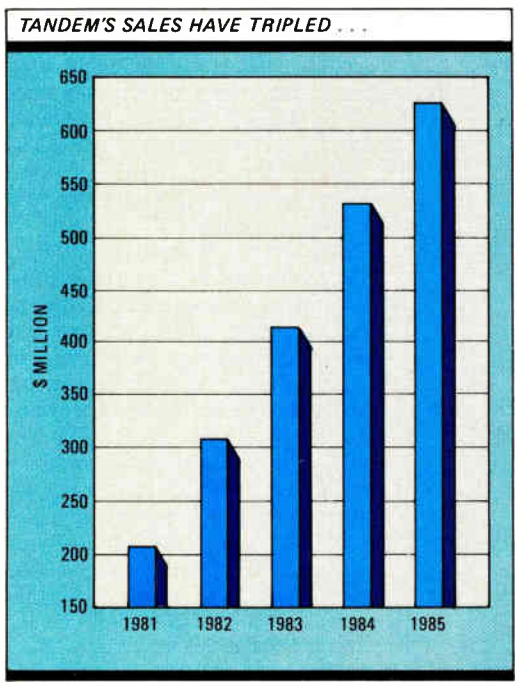
On the business side, says Treybig, Tandem's major achievement is its performance against IBM. "We forced them to buy someone else's computer," he says proudly, referring to IBM's use of equipment made by Stratus Computer Ltd., Natick, Mass., in some of its transaction-processing applications. In addition, Treybig adds, AT&T had to come out with a hardware-redundant machine, the 3B20, to compete with Tandem in on-line computing.

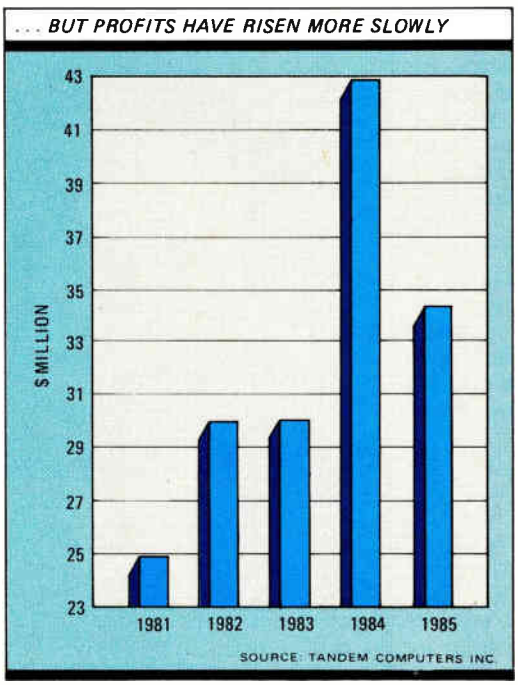
'THREATENING.' Indeed, says Stephen K. Smith, an analyst at Paine Webber Inc., New York, Tandem is a "threatening competitor" to IBM in transaction processing, a market IBM has traditionally dominated. IBM has mounted a significant effort to stop Tandem from taking away business, Smith says.

But Tandem's networking ability will keep the company a jump ahead of Stratus, IBM's supplier, says Michael Murphy of the *California Technology Stock Letter*. "They are clearly the leader [in transaction processing] and they can sell a network, not just one or two machines," Murphy says.

To broaden its markets, Tandem is beginning to introduce message-handling software. It is beginning to offer a range of information-transfer programs, including electronic mail, data communications, facsimile, and microcomputer-to-mainframe communications. Its networking software supports both IBM's LU.6 Systems Network Architecture and the International Organization for Standardization's open-systems interconnection reference model.

Tandem also sees opportunities in factory automation and was one of the first companies to support the General Motors Corp.-sponsored Manufacturing Automation Protocol. Late last month, Tandem bought a small piece of Triplex, a Torrance, Calif., maker of fault-tolerant programmable logic controllers, and the two will jointly produce a MAP system. "We are far ahead of anyone on networking software and distributed data bases," Treybig says in summary. "Others build networks on top of individual processors. Our lowest-level operating system is a network. That is unique." □





IS COMPUTER CONFERENCING FINALLY EMERGING AS A TOOL?

THIS INTERACTIVE TECHNIQUE BEGINS TO CATCH THE EYE OF INVESTORS

by Clifford Barney

PALO ALTO

Computer conferencing, the orphan of the telecommunications industry, may be finally emerging as a legitimate technology. Not only is there microcomputer-based conferencing software in the wings and networking companies on the prowl for innovative applications, but now computer conferencing is beginning to catch the eye of major investors.

Dean Witter Reynolds Inc. is the latest big booster; W. J. Cara, one of its analysts based in Toronto, Canada, is an unabashed fan who convinced the brokerage to arrange for a private placement for a promising conferencing company. Declares an enthusiastic Cara: "Computer conferencing is the next spreadsheet."

That company was NETI Technologies Inc., Vancouver, B. C.; several months later Dean Witter took it public. NETI alone is shooting for $10 million in sales this year and for $250 million by 1990, claims Cara. It had just over $1 million in 1985. On the other hand, a recent estimate put the entire market for computer conferencing at about $8 million for services and $2.75 million for software licenses.

NETI's operating subsidiary, Network Technologies International Inc., Ann Arbor, Mich., now has more than $20 million to spend—more than the entire computer-conferencing market is projected to generate this year. Despite the growing enthusiasm, however, it won't be an easy job to grow this market. Jeffrey J. Elpern, NETI's vice president of marketing, says "this is a new technology. We have a major marketing education job in front of us."

They certainly do. No one has ever figured out how to make a profitable business out of computer conferencing. Executives are skeptical about using computers, and unfriendly software has done nothing to change their attitudes. Even smoother second-generation systems are no guarantee of a market. Conexus, a Beaverton, Ore., company that had already tested some conferencing products, gave up on a microcomputer-based system because it could see no way to make money on it.

Some people still feel that way about computer conferencing. It's a very small business and will stay that way, maintains Herbert S. Dordick, a professor of communications at Temple University and a communications consultant who has studied network applications. He considers the technology a variation of teleconferencing that will never replace direct contact. But NETI president Lawrence B. Brilliant says that video conferencing and all other synchronous methods of communication are ultimately unsatisfactory because they are not easily organized or searched. Computer conferencing, expressible in words, is cheaper and more useful, he insists.

One reason is that computer conferencing is a new dimension in communication between humans as well as between machines. Most computer communication is devoted to the efficient routing of data and code. The whole idea is to make the network look like a seamless whole. Only recently has electronic mail, which not only acknowledges the presence of other entities but actually requires them, been included in networking packages.

WHOLE ENVIRONMENT. Electronic mail is just a utility, however. Computer conferencing is a whole environment that can help users interact with other people on a net, much as they use windowing to interact with the hardware, backers say. Using it, large groups of people can cooperate on a project even though they are separated by great distances. Besides organizing group and interpersonal messaging, it also makes large text and data bases mutually accessible.

Computer conferencing has been around since the 1970s, but the early systems were based on minicomputers or mainframes. They were expensive and either experimental or limited in scope. A number of large companies and universities developed in-house systems, but only one commercial system—from Infomedia Corp., Menlo Park, Calif.—got a toehold in the market.

Now with second-generation conferencing software becoming available, computer conferencing becomes more attractive, particularly as companies begin to wire themselves into local-area networks (LANs). "The biggest use of computer conferencing will be in internal operations within a single organization," figures Murray Turoff, designer of the Electronic Information Exchange System (EIES) at the New Jersey Institute of Technology. Systems will get a free ride on LANs, Turoff adds. That's a switch because computer conferencing

TUROFF: Systems must be tailored if they are to succeed commercially.

grew up piggybacking on the telephone system as a means of linking people over large distances.

However, Turoff contends that only companies that spend money on tailoring their systems for special purposes can hope to make it commercially. "The general-purpose data-processing centers that survived are those that invested in the development of specialized software in particular fields like health and banking. Those conferencing suppliers that want to survive need major development efforts and a clear set of objectives related to the market they want to service."

NETI plans to start by offering products across a variety of hosts and systems. It will supply multiuser systems for large corporations, running under the VM, VMS, and AT&T Co.'s Unix operating systems, and an IBM Corp. Personal Computer-based system running under MS-DOS. "By the end of the year, we will have a product for every operating system," says NETI's Brilliant.

NETI has also developed a Unix-based application for joint document preparation and signed an agreement for AT&T Communications Inc. to market it. And it sells conferencing services through General Electric Information Services Co., which runs one of the world's largest commercial telecommunications networks.

Commercial pioneer Infomedia is getting into the act by adapting its 10-year-old Notepad software to the new age of microcomputers. The company stresses the simplicity of Notepad—users can access it through the nine number keys on a standard keyboard—and goes to great lengths to establish the security of its system.

Infomedia got into the market prematurely, says vice president C. Renwick Breck (see "Eclectic threesome boosts conferencing"). It almost foundered after incurring heavy development costs and then becoming nearly captive to a single customer, a consortium of nuclear power plants. Breck led a group that bought out Infomedia's founders and is now restructuring the company. Infomedia has provided the nuclear plants with their own systems and begun developing new products, including an MS-DOS version of Notepad; it also plans to merge Notepad with Data General Corp.'s information-management package, CEO.

NETI and Infomedia have the infant market nearly to themselves. But a dozen or more systems are in use both publicly and inside such large corporations as Citibank, Digital Equipment, Exxon, Hewlett-Packard, Honeywell, IBM, Procter & Gamble, and Xerox.

NETI has written two conferencing systems from scratch; it recently bought out its chief competitor, Participation Systems Inc., causing a flurry of interest in the close-knit conferencing community. Participation Systems created Parti, a conferencing package that was one of the first portable systems but which had a tendency to fragment into different discussions. NETI will eventually merge Parti and its own eForum software. The merger left only Infomedia, which NETI had also tried to buy, as a commercial rival to NETI. Two national videotex services—the Source and Compuserve—also supply confer-

ECLECTIC THREESOME BOOSTS CONFERENCING

The backgrounds of the three leading players in computer conferencing could hardly be more diverse: one was a physicist, one a physician, and the third was a U. S. senator's aide.

The physicist, Murray Turoff, is the designer of the Electronic Information Exchange System (EIES) conferencing system and coauthor with sociologist Starr Roxanne Hiltz of the canonical computer-conferencing text, *The Network Nation*. He also was instrumental in developing the prototypical conferencing system, Emisari, in the late 1960s for the Presidential Office of Emergency Preparedness. A marketing realist, Turoff is not convinced that the technology has a great commercial future. "If I wanted to go out and make some money right now in this technology, I would concentrate on a simple-minded system devoted only to allowing people to find three others at any hour of the day or night to play contract bridge," he says.

Lawrence B. Brilliant, a physician and founder of Network Technologies Inc., worked on the successful U. N. project to eliminate the smallpox virus. Teaching at the University of Michigan, he met the developers of the Confer system, which is at the heart of the present products from NETI Technologies Inc., the parent company.

C. Renwick Breck, vice president of Infomedia Corp., was a protégé of the late Sen. Hubert H. Humphrey and wrote some of Humphrey's social legislation. He later became interested in the development of new technologies and pioneered in the use of Landsat for mapping applications. Breck saw conferencing as a medium for crisis management and bought Infomedia when its owners, who had taken over from founder Jacques Vallee, seemed ready to fold it.–*C. B.*

encing, and several regional networks—Unison in Denver, the New England Commons in Newton, Mass., and The Well in Sausalito, Calif.—offer it as a part of quasi-public information utilities.

Some observers believe that with the Participation Systems acquisition, NETI has established itself as boss of whatever computer-conferencing market exists. But NJIT's Turoff, who has led the technological development of computer conferencing for more than a decade, says the medium is too flexible for any one company to capture it all.

ULTIMATE MARKET. "The ultimate marketplace will be made up of a wide variety of different systems catering to different applications and different needs for communications," Turoff says. "There is no one best design. The best computer-mediated communications system will be highly tailored to the applications of the group using it."

One typical tailored application, Turoff says, will be in data-base systems. These, he contends, will in the future have integral conferencing structures so that many users can use them jointly. The software, he adds, will be cheap and distributed throughout a computer system to reduce communications costs.

EIES is developing its own next-generation conferencing software, under the general designation of EIES 2. It is funded jointly by the State of New Jersey and IBM. EIES 2 systems are written in C and use X.400 data structures to allow for inclusion in distributed systems. Versions are in the works for Unix System V, IBM's VM/CMS, and MS-DOS. These products will be licensed commercially, Turoff says, and NJIT is seeking industrial partners.

NJIT's Turoff is convinced that a new class of "information brokers" will be required to provide the technical assistance to get a computer conferencing market off the ground. They are just as important, he says, as data-base administrators. EIES has long had its own online "user consultants," a kind of electronic ski patrol for assisting the inexperienced.

Last April, a group of conferencing professionals formed the Electronic Networking Association to spread the gospel of computer conferencing. Members—about 60 altogether—confer with one another electronically in messages that are ported across network boundaries by diligent volunteers.

The most common topic of their messages: how to overcome corporate resistance to computer conferencing. Members agree that the technology, however problematic, is not the main barrier. "You are not dealing with technology," says one corporate manager of a computer conferencing system. "You are dealing with social change." □

U.S. CHIP MAKERS GO ALL OUT TO HIKE JAPANESE SALES

FAIRCHILD, AMD, AND INTEL SAY TRADE PRESSURE WON'T WORK

by Michael Berger

TOKYO

A growing number of U.S. semiconductor makers are dramatically increasing their presence in Japan in an all-out effort to carve out a bigger market share that won't depend on government negotiations.

Out in front of the pack is Fairchild Semiconductor Asia Inc., Tokyo. "No matter how much trade pressure we put on the Japanese, they simply won't buy many American semiconductor products unless they're made in Japan. That's why we're producing here, and that is why we expect to succeed here," declares Ronald C. Norris, executive vice president.

Other U.S. chipmakers now making a much stronger Japanese effort include Advanced Micro Devices Inc., Intel Japan Ltd., and National Semiconductor Japan Ltd. They have done such things as increase their engineering staffs, reorganize sales and marketing operations, and focus on niche markets such as application-specific integrated circuits and factory and office-automation applications, where they expect to show double-digit sales growth.

Though U.S. makers have long considered local manufacturing as one of the best ways to increase their Japanese market share, they usually have shied away from making the investment. Now the trend seems to be moving in that direction. Fairchild is making products in Japan, and AMD seems headed in that direction although U.S. executives discount any plans to do so. Although Intel does not yet produce in Japan, Eugene J. Flath, Intel Japan director, says "we have strong interest in doing so at some time in the future." Industry sources say that's likely to happen within the next two or three years. Meanwhile, Intel's Tsukuba design center, which formerly did 80% of its work for the U.S. market, is now designing 100% of its products specifically for Japan.

U.S. companies that have been running successful local semiconductor plants are either turning out products for their own use or for non-Japanese markets. As a result, their impact on U.S.-Japan semiconductor trade and American penetration of the Japanese market have been minimal [*Electronics*, July 15, 1985, p. 30]. Texas Instruments Japan Ltd. has concentrated local production primarily on memory products for foreign markets. And most of Nippon Motorola Ltd.'s Japanese production is for its own use and export. IBM Japan Ltd., of course, produces exclusively for its inhouse users.

Now beginning to make a dent in the Japanese market too are U.S.-owned application-specific IC makers such as Asahi Microsystems (a joint venture between Gould and Asahi Chemical), Harris, LSI Logic Japan, Monolithic Memories, and Signetics. They all have design centers in Japan. The new strategies of AMD, Fairchild, and Intel, however, should result in a much bigger payoff because they have broader product lines and proprietary designs.

RONALD NORRIS: To sell in Japan, semiconductor products must be manufactured in Japan.

"I expect our sales to exceed $300 million in Japan by 1990," up from $65 million in 1985, says James Shinn, general manager of AMD's Tokyo operation. His strategy to reach that goal is as concise a package as one of his high-performance ICs.

"There are three key ingredients to succeeding in this market," says Shinn, "and none of them is any secret—advanced technology, superb quality, and reliable, prompt sales/service support. If you don't have all three, you die. We've put those three musts in place."

The big question is how much such moves will help—Japanese customers are notorious for their demands on chip makers and designers. A manager for a major customer says, "Even though our people often speak English, we don't like to have to go all the way to California to work out a problem. We much prefer to work here at home, with the Japanese staff of our American supplier. Whatever the U.S. companies do to increase their presence in this market is going to pay off for them, especially if they keep pushing into these application-specific IC markets."

AMD's sales line is clearly directed toward the high-growth office automation market in Japan. At its heart are the company's 9300 family of microprocessors, its 9580 and 9581 disk controllers, its 95C60 16-bit controllers for factory-automation and graphics applications, and its new line of 32-bit microprocessor building blocks for artificial intelligence and advanced computer tasks.

"Technology is one thing," Shinn says, "but supporting it is equally crucial, and we've made important changes to improve our support and provide fast turnaround." Since January, AMD has handled production of all the products Shinn is marketing exclusively in Japan at two lines in that part of the world: in Malaysia and Singapore. The company also has written new specifications for these products to satisfy Japanese customer needs.

Two months ago, AMD and Sony Corp. agreed to jointly develop IC products both can produce and market worldwide. But Ben Anixter, vice president for corporate marketing at AMD headquarters in Sunnyvale, Calif., says there are no current plans to set

U.S. SELLS FEW ICs IN JAPAN

Companies	1985 sales ($ million)
Texas Instruments Japan	205
Intel Japan	85
Nippon Motorola	70
Advanced Micro Devices	65
National Semiconductor	35
Fairchild Semiconductor	30
Signetics	15
Monolithic Memories	9

Note: IBM Japan produces in-house only — statistics are unavailable.
SOURCE: *ELECTRONICS*

up a fabrication line in Japan.

Nevertheless, "U.S. makers are taking up the Japanese challenge and coming here to produce," says Peter G. Wolff, vice president of Prudential-Bache Securities Far East Research in Tokyo. "They also realize that they can't serve Japanese customers properly from thousands of miles away."

Wolff notes that by committing themselves to an expanded presence in Japan, the American makers will benefit by increasing their knowledge of Japanese production engineering and customer needs.

AMD has made a move in that direction by transferring a senior American engineer to Tokyo, giving the person intensive language training, and putting the engineer in charge of developing and leading a quality-assurance staff.

Intel's design and assembly center in Tsukuba has made similar changes. "We've consolidated what used to be three engineering groups—a pilot ASIC group and two satellite design centers which used to do work only for U.S. customers—and made them into a single unit that designs ASICs and microprocessors exclusively for the Japanese market," says Intel's Flath.

Japanese industry sources say that Intel's reputation for technology had not been matched by its service support record. "They did not seem well-organized," says one manager. "It hurt their reputation. They seem more committed to service now, but we'll have to see."

Flath acknowledges these complaints, and says he came to Japan to correct Intel's internal problems. "My goal is to eliminate the need for me to be here," he says.

Intel also appointed a new sales manager for Japan, reduced the number of accounts per salesperson, and changed assignments "to promote some good people and strengthen our ability to serve an account," says Flath. The results: a 15% turnover in staff, but predictions of 10% to 15% growth in sales this year from last year's $85 million, mostly in special ICs for office and factory-automation applications.

PRODUCTION UP. Fairchild's commitment to Japanese production began in 1984, when it invested close to $100 million in a plant in Isahaya City, near Nagasaki. But managerial changes resulting from its takeover by Schlumberger Ltd. set back production goals. Executive vice president Norris arrived in Japan early last year to head a new management team. He says the plant, which was turning out 3 million units a month of its CMOS static random-access memories, standard TTLs, and other products last year, now produces 10 million, most of them low-end-market devices bound for Southeast Asia.

Between 50% and 60% of all units produced are now bound for those markets, but in value terms, the percentages are reversed because of the gate-array 32-bit-microprocessor ASICs Fairchild markets in Japan. Fairchild, which also will start up a 6-in. wafer-fabrication line by early 1987, has doubled its plant production staff to 200. The company also has opened a sales office in Nagoya, where this fall it will open a technical center.

National Semiconductor is also getting more aggressive in the Japanese market. It has added nine Japanese engineers to its overall staff of 110, is introducing at least eight designs especially for Japanese customers, and expects sales to grow between 20% and 25% by the end of 1986 from the 1985 total of $35 million.

But National will not say if or when it will build a Japanese plant. "We're actively defining precisely what we must do to meet the needs of this market," says subsidiary president William G. Watson. □

JAMES SHINN: "I expect our sales to exceed $300 million in Japan by 1990," says AMD's general manager in Tokyo.

A 'NEW' APPLICON TRIES TO REGAIN EDGE IN CAD/CAM

REORGANIZED SCHLUMBERGER UNIT, 'VERY WEAK' IN RECENT YEARS, IS COMING OUT WITH A BROAD LINE OF NEW PRODUCTS

ANN ARBOR, MICH.

Once Applicon was among the leaders in the computer-aided-design business, but no more. Since the 1982 onslaught of advanced 32-bit engineering work stations, its market share has dwindled and its profits turned to losses. So far, the company has been silent on the Unix work-station front, with a product line based strictly on Digital Equipment Corp.'s VAX/MicroVAX VMS operating system. But the newly reorganized operating unit of Schlumberger Ltd. is out to regain its past prominence, beginning at next month's Computer Graphics '86 show in Anaheim, Calif.

Last July, Schlumberger moved Applicon's headquarters from Burlington, Mass., to Ann Arbor, where it combined Applicon's operations with those of another Schumberger operating unit, Manufacturing Data Systems Inc. MDSI was acquired by Schlumberger in early 1981, Applicon in late 1982.

Applicon is hoping that the mix of its design strength with the products of MDSI, which is strong in computer-aided manufacturing, will give it the means to offer a unique front-to-back CAD/CAM capability. The old MDSI was a significant player in the mechanical CAM business, featuring a strong lineup of software products that run primarily in a VAX/MicroVAX environment.

At the Anaheim show, "the new Applicon," as officials here are fond of calling it, will roll out a product line that combines the formerly separate lines of the two subsidiaries into a single integrated product family. The company will jump on the 32-bit Unix work-station bandwagon for the first time by offering a new work-station package on a Sun Microsystems platform as well as on its traditional VAX/MicroVAX base.

SOFTWARE INTEGRATION. The old MDSI line includes tools for numerical-control programming, complex surface machining, and sheet-metal design and application, for example. With the combined Applicon/MDSI line, "our strength is going to be the integration of various pieces of software that I think the industry is going to be surprised at," says president Richard A. Mohrman.

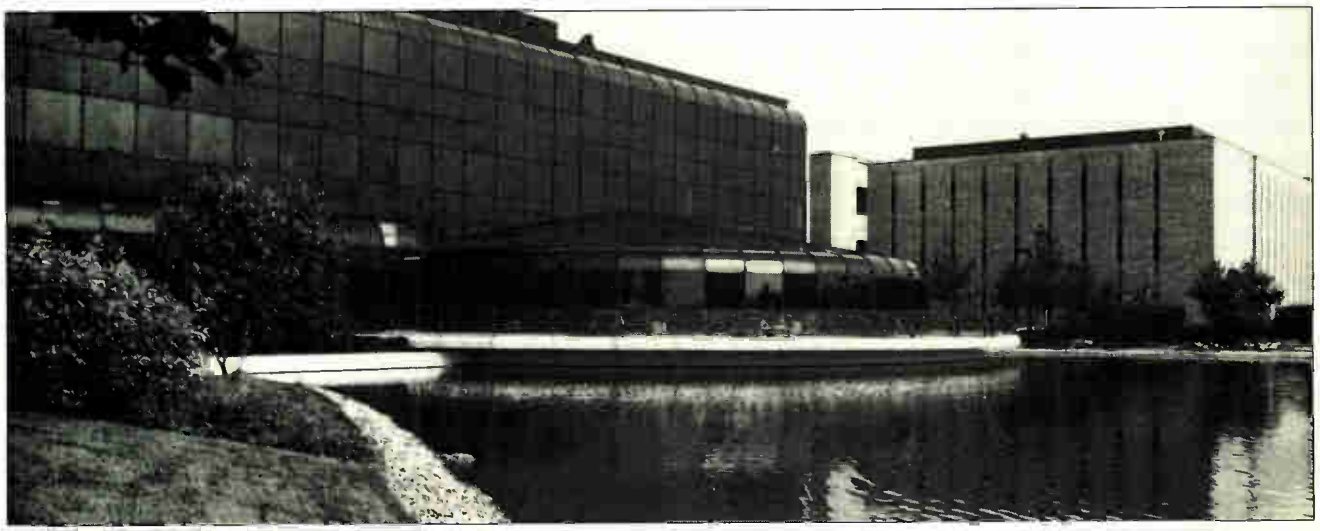
As a key part of its strategy, Applicon hopes to reestablish its lost prominence in electronic CAD. It already has a presence in 32-bit mechanical CAD with its Bravo line, introduced in 1983. Included in the new line—which will keep the Bravo family name—is a 32-bit electronic printed-circuit-board design package encompassing schematic-design capture, circuit simulation, interactive layout, and automated placement and routing. "Applicon has been very weak on the electronics side for three or four years, and this should get us right back in there with the good ones," says Mohrman.

Its market share fell from 15% to 3.2% since the late 1970s

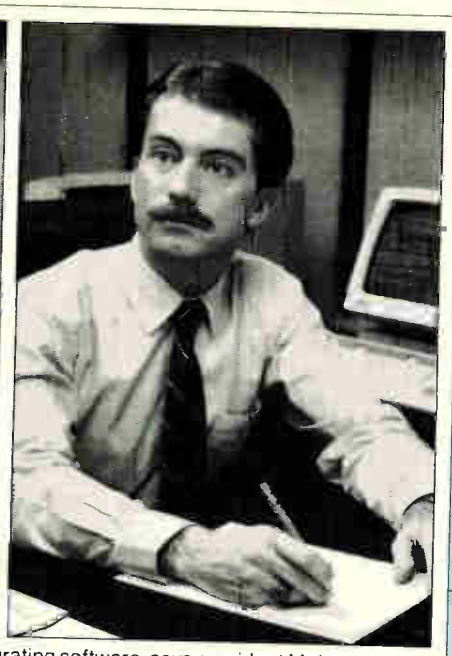
Topping off the Anaheim show package is a new line of graphics terminals for the VAX-based market. These terminals can also be outfitted with a Sun central-processing-unit board to work as a stand-alone unit in the world of AT&T Bell Laboratories' Unix operating system. "A month from now, somebody might come out with something different, but right now, there's nobody that can touch it from a graphics point of view," Mohrman says. Officials are sketchy with details but say the Applicon graphics package will outstrip the competition in such typical graphics parameters as resolution, vectors per second, and speed.

The addition of the Sun platform will offer a badly needed capability for Applicon, says Bryan F. Barton, director of electronic marketing. VAX and MicroVAX work station-based equipment "will remain a very major focus of our developmental and marketing activities. But some people prefer a Unix nonproprietary-type capability. And on Sun, you also have what I would call true windowing and true networking in the sense of the ability to have diskless nodes and the like. DEC has not yet stepped up to that in terms of a work station."

For Applicon, the new-product moves are an effort to stop a market slide of recent years. As one of the original CAD/CAM turnkey-system vendors, Applicon held a 15% to 20% share of the market in the late 1970s. But its share dwindled to only 3.2% of a $3.4 billion CAD/CAM market in 1985, and that includes revenues from the former MDSI, says Vicki J. Brown, a senior analyst at market researcher International Data Corp., Framingham, Mass. Schlumberger does not break out the numbers for its unit, but Brown estimates that Applicon's revenue was flat in 1985 at about $110 million—enough to rank the company 11th in 1985 sales among



SYNERGY. Applicon's operations were combined with those of Manufacturing Data Systems Inc. at a new headquarters in Ann Arbor.



ON THE ATTACK. Applicon's strength is in integrating software, says president Mohrman (left), and a new platform will boost the capability of its line, says marketing director Barton.

CAD/CAM vendors, she says.

The groundwork for the Applicon/MDSI merger was laid in 1983, when Mohrman came to MDSI from another Schlumberger company to head the then-unprofitable Ann Arbor operation. "In late 1983, we started making plans to bring the two companies together, and the early plans were around product development to make sure the two groups weren't going off on tangents," Mohrman says. "By early 1985, we brought the two product lines together and each sales force sold each other's product lines. In mid-1985, we took the next step, which was to bring the two companies together."

SHIFT OF FOCUS. An 11-year Schlumberger veteran, the 51-year-old Mohrman successfully restored MDSI to profitability in 1984 by killing some old products and hastening the development of new ones. Now Mohrman is charged with executing a similar reversal of fortunes at Applicon. "MDSI was profitable in 1984 and 1985, but Applicon lost money in both of those years. And the losses at Applicon exceeded the profits at MDSI," he says.

But already, the new Applicon is showing an operating profit, he notes. That's thanks in part to savings achieved through elimination of some 150 jobs in consolidating previously separate accounting, marketing, and sales-management staffs into one operation, together with a few reductions at the field offices.

Though some nontechnical positions were pruned in the consolidation, engineering was not cut back. The old MDSI contingent of about 150 engineers remains in place. A like number of engineers in the old Applicon product-development group was maintained in Billerica, Mass., as was all the manufacturing for the new company.

The merger has not been without problems. "Quite a bit of employee loyalty was lost at Applicon when people who were out in Burlington were told that in order to keep their jobs they had to transfer to Ann Arbor," notes IDC's Brown. "They had a lot of turnover and a lot of very unhappy people."

The task ahead of Applicon is what Mohrman calls "a classic marketing chore. For one thing, we've got to reestablish Applicon's image on the electronics side of the business," he says, adding that an important job also still lies ahead in training and educating the sales and support staff on the soon-to-be-announced new-product package.

Applicon will face fierce competition and pricing pressure in its bid to make a CAD/CAM comeback. Some 300 companies are today pursuing a CAD/CAM market that is expected to reach $9.9 billion worldwide by 1989, says Dataquest Inc., San Jose, Calif.

But Mohrman is banking on the integration of both mechanical and electronic design with MDSI's expertise in a single CAD/CAM system. Applicon's new line will go beyond most competitive products in its breadth of electromechanical CAD/CAM capabilities, he says, which should prove attractive to potential users. After all, Mohrman says, "it's a rare customer today who makes mechanical products who doesn't also have a need for electrical and electronic capabilities. And it's also a rare electronics firm that doesn't have a need for mechanical."

–Wesley R. Iversen

BOTTOM LINES

PRIME NOW EXPECTS A DROP IN EARNINGS

Superminicomputer maker Prime Computer Inc. now expects its earnings in the first quarter of 1986 to fall 25% below last year's first quarter, although revenue will rise 10% to 15%. The Natick, Mass., company blames the profit drop on a combination of continuing strategic investments and fewer than expected shipments. In light of the industry's ongoing sluggishness, Prime has also reassessed its 1986 operating plan and has decided to limit investments and hiring to key areas. The company recently said these areas include research and development and sales [*Electronics*, March 17, 1986, p. 58].

MAXTOR STOCK ISSUE RAISES $30 MILLION

Maxtor Corp. has raised $30.8 million from a public offering of 1.5 million shares of newly issued stock. The Santa Clara, Calif., company makes high-performance 5¼-in. Winchester disk drives with 380-megabyte capacity. Only last August, it raised $17.4 million through its initial public offering. Since then, its stock has risen from $11 to about $20.50.

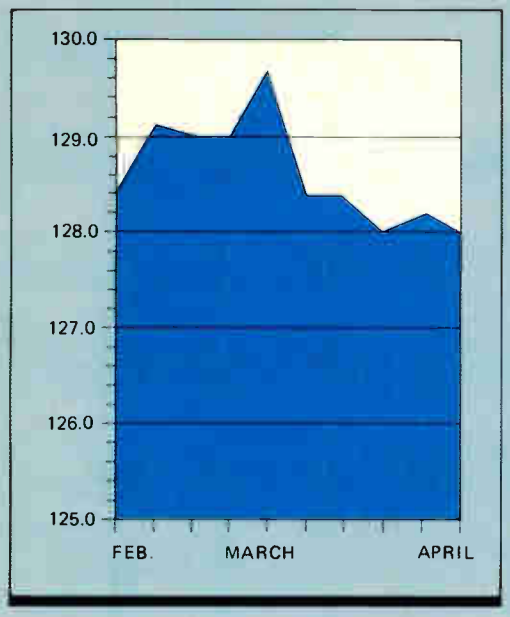
CHIP EQUIPMENT MAKERS MERGE

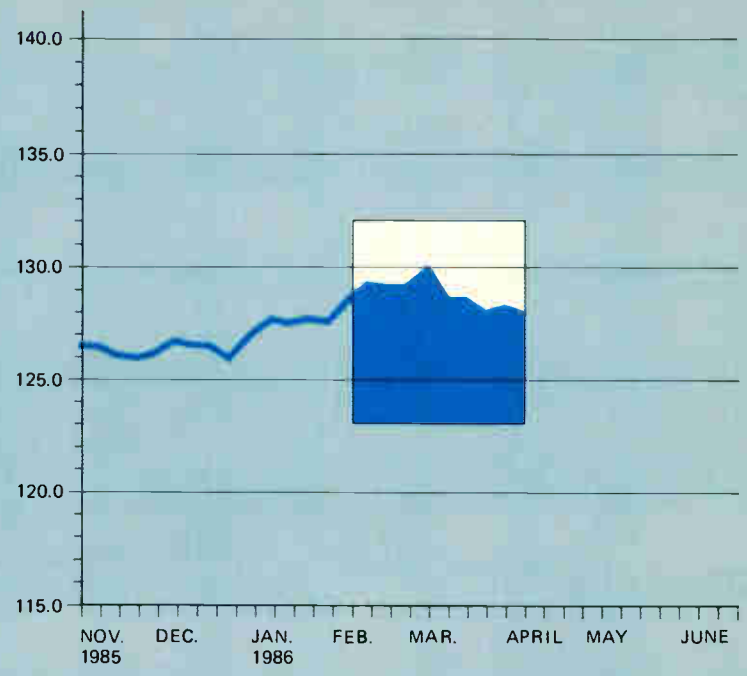
Two California semiconductor equipment manufacturers, Silicon Valley Group Inc. of San Jose and AG Processing Technologies of Sunnyvale, have agreed to merge. Under terms of the deal, which involves a stock swap of undisclosed volume, AG Processing Technologies will become a wholly owned subsidiary of Silicon Valley Group. AG Processing Technologies, founded in 1981, specializes in rapid thermal processing of wafers. Its technology complements Silicon Valley Group's recently announced vertical thermal reactor technology.

DALLAS FIRM MAKES NEW DEBT OFFERING

Taking advantage of lower interest rates, Recognition Equipment Inc., the Dallas maker of optical and magnetic-ink character-recognition systems, has made a public offering of $45 million in debentures. Proceeds from the offering, which carries an interest rate of 7.25%, will be used to redeem an earlier issue of Recognition Equipment debentures that had an 11% rate, and to reduce the company's debt under a revolving-credit agreement.

ELECTRONICS INDEX





THIS WEEK	= 128.0
LAST WEEK	= 128.2
YEAR AGO	= 130.8
1982	= 100.0

The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U. S. ELECTRONICS INDUSTRY EMPLOYMENT

Production workers (thousands)	January 1986	December 1985	January 1985
Office and computing machines	170.1	171.8	200.9
Communications equipment	284.3	286.4	295.5
Radio and TV receiving equipment	56.4	57.4	58.5
Components	344.3	346.3	408.7

U. S. GENERAL ECONOMIC INDICATORS

	February 1986	January 1986	February 1985
Index of leading economic indicators	175.4	174.1	167.4
Budgeted outlays of the federal government ($ billions)	78.290	82.849	74.851
Budgeted outlays of the Department of Defense ($ billions)	21.268	20.945	19.785
Operating rate of all industries (% capacity)	77.6	78.3	78.9
Industrial-production index	125.7	126.5	123.7
Total housing starts (annual rate in thousands)	1,985	2,056	1,632

Those who were hoping for continued signs of economic improvement in the U. S. electronics industry have received a new jolt: employment continues to fall. The number of production workers in January dropped 0.8%, following a decline of 0.6% in December and of 0.7% in November. The latest slash in electronics industry payrolls follows more than a year of consecutive monthly cuts. From January 1985 to January 1986, more than 108,000 production workers lost their jobs in the electronics industry—a drop of over 11%.

What's more, January marked the second consecutive month in which all electronics-industry sectors pared worker ranks. Even manufacturers of radio and TV equipment trimmed payrolls 1.7% in January. Employment in this sector has been relatively strong, falling by just 2,100, or 3.8%, during the past year. That's much better than the components sector, which cut employment by 0.6% in January alone. For the past 12 months, components employment has dropped by 64,000, or 15.8%.

A BUSY ISAACSON STARTS TWO NEW COMPANIES

SEATTLE

Portia Isaacson could write a book about changing computer careers for fun and profit. For starters, she has worked as a software engineer, teacher, computer retailer, and market research executive. Now she is busily starting up two companies, one of which is pioneering an industry.

A veteran of the microcomputer field, Isaacson started out designing real-time operating systems for mainframes and minicomputers. Armed with four degrees, including a PhD in computer science from Southern Methodist University, she taught classes in programming and computer architecture at North Texas State University and the University of Texas at Dallas.

RETAIL TO RESEARCH. In 1976, as personal computers were starting to take shape, she opened a computer specialty shop called The Micro Store. Four years later, she began Future Computing Inc., the Dallas market researcher that rode the rising tide of the microcomputer boom years. McGraw-Hill Inc., which publishes *Electronics*, purchased the company in June 1984.

With part of the money received from that sale, Isaacson, 43, and husband Egil Juliussen, who nows runs Future Computing as chairman, built a completely integrated electronic home. The home features a telecom-equipped office and electronic control of climate, security, kitchen, and entertainment systems.

The house serves as a base for the first of Isaacson's two new ventures: Intellisys Corp., which she formed to develop software for similar intelligent houses of the future (see story, p. 24). The three-month-old company should gross between $500,000 and $1 million this year, Isaacson says.

"The game plan in the first few years is to work with the manufacturers in research and development to help develop the concepts, products, and market understanding that's going to get this started," Isaacson explains. "What we're doing is making a commitment to help the market for electronic homes develop."

While the house was coming together, Isaacson obtained a Texas license to sell securities. That was necessary for her second startup, which made its debut last December. Called Isaacson Inc., the company consults on mergers and acquisitions for the computer industry.

Technical smarts and a large network of computer industry contacts allow the company to market its services in a field dominated by old-line investment banking houses. Right now, Isaacson and her two employees are targeting computer retailers and have under contract six companies looking for a buyer. Next, Isaacson Inc. will go after makers of peripherals and boards.

And as a recently

PORTIA ISAACSON: One new venture after the other.

PEOPLE ON THE MOVE

J. DANIEL McCRANIE

☐ Seeq Technology Inc. has named J. Daniel McCranie president and chief executive officer, succeeding E. Floyd Kvamme. Appointed vice president of the San Jose, Calif., company in December 1982, McCranie has been responsible for marketing and sales since September 1983. Before joining Seeq, he was group vice president of sales at Harris Semiconductor.

CHARLES A. ZRAKET

☐ The board of trustees of Mitre Corp., Bedford, Mass., has elected Charles A. Zraket president and chief executive officer, effective July 1 when current president Robert R. Everett retires. Zraket has been with the systems-engineering company in positions of increasing responsibility since it spun off from MIT's Lincoln Laboratory 25 years ago. In 1978, he was appointed to his present position as executive vice president and chief operating officer.

W. LOUIS WOOLDRIDGE

☐ Digital Switch Corp., which opened an office in Tokyo following a major systems sale last fall to Daini-Denden Inc., named W. Louis Wooldridge its first director of Far East marketing. Daini-Denden will open services next year as one of the new competitors to common carrier Nippon Telegraph & Telephone Corp. Wooldridge, 42, comes to his new assignment after three years as director of product planning for the Plano, Texas, company. He had been manager of switching systems engineering for Sprint and MCI Communications Corp. Wooldridge will also be in charge of DSC Japan Inc., Digital Switch's recent joint venture with Mitsubishi Corp.

JOHN N. LoPRESTI

☐ Houston's Quasitonics Inc. has named John N. LoPresti president. Most recently, he served as vice president of commercial sales for Toom Systems Inc., where he was responsible for sales in North America. Prior to that, he served in executive marketing positions for ITT Communications Services Group and IBM Corp.

JOHN J. REIS

☐ Charged with directing Case Communications Inc.'s expansion in the U.S. market, John J. Reis has been elected president of the Columbia, Md., data-communications company. It is the U.S. subsidiary of Case Group plc, Watford, England. Reis joined the company in 1985 as senior vice president of marketing, where he directed the integration of Case Group and Rixon Inc. Case acquired the Silver Spring, Md., communications equipment manufacturer in 1983, forming what is now Case Communications. He previously was president of Telesciences Inc. and held senior sales and marketing positions with IBM Corp.

HOY Y. CHANG

☐ Zenith Electronics Corp. has named Hoy Y. Chang president of its wholly owned subsidiary, Zenith/Inteq Inc. The Herndon, Va., company designs and markets high-security microcomputers and peripherals as well as products for military and high-security applications. Chang moves over from Zenith Data Systems Corp., which he joined in 1981 as vice president of engineering. Before that, he was with Burroughs Corp. in Detroit. Chang succeeds Winfree P. Tuck, who resigned Feb. 28.

R. WAYNE NELSON

☐ Repco Inc., a manufacturer of radio, telemetry, and wireless security equipment in Orlando, Fla., has named R. Wayne Nelson as its president and chief operating officer. Nelson rejoins Repco after a stint as vice president of sales for Oki Telecom. In the 13 years prior to joining Oki, Nelson served as general manager of Repco's Secode Electronics Division, customer service manager, and director of both sales and operations.

elected member of the board of directors of Microsoft Corp., Redmond, Wash., Isaacson is well aware of acquisition trends in the microcomputer software market. Because venture-capital funding for software companies has dried up, "everybody's a buyer or a seller." Three or four years ago, she says, software houses might talk about buying another company, but nobody was selling. Today, virtually everybody is one or the other, and most companies are selling, she says.

"They all have to be open to the idea of discussing a merger," says Isaacson. "Not necessarily for financial reasons, but because they can't reach the market. They don't have the clout, they don't have the name, they can't get the distribution channel."

Microcomputer software giants see acquisition as one way to grow, she says. Ashton-Tate and Lotus Development Corp. are two that have "been very aggressive in their acquisition activity, and I expect them to continue." If they do, it may be some time before Isaacson writes that book. *–Alexander Wolfe*

CHIASSON FINDS A GOOD FIT AT MIDSIZED ALSYS

BOSTON

Peter Chiasson says he's the wrong guy for a startup or for a billion-dollar company, because he doesn't like big bureaucracies or brand-new situations. That's why medium-sized Alsys Inc. was just right. Since December, Chiasson has been president and chief operating officer of the U. S. subsidiary of Alsys SA in La Celle St. Cloud, France, a three-year-old company that develops and markets Ada language products. And the company is poised for a surge, says Chiasson.

PETER CHIASSON: Listening for the gong at a reoriented Alsys.

"There is no more technical risk," says the tall, 44-year-old Chiasson. "Ours and other compilers are done and validated." What's more, he adds, with the introduction by Alsys of a full-function Ada compiler for the IBM PC AT, the language has the widely available platform needed for broad usage.

The challenge confronting Alsys and other Ada companies is to expand their base beyond the Defense Department, Chiasson says. Commercial uses are desired, and Alsys is trying to get third-party testimony on the language's advantages on these applications.

EMPHASIZING BUSINESS. "It's important for Alsys to move from being a technical leader to being a business leader," says Chiasson. "I've got two problems. One is to get orders." The second, he says with a chuckle, is "all the other problems."

The goal is to triple the size of the company, says Chiasson. He emphasizes the priority by having employees bang a large gong in the office whenever an order is placed. "I don't care if the President of the United States is here—I'll get up to shake the salesperson's hand" when it sounds, says Chiasson.

This is a major internal transition for a company that heretofore concentrated on technical issues. In fact, the ringing gong was not immediately accepted. One technical employee even complained about the noise. But Chiasson says that after he explained the need to shift gears, the same person had a different complaint. "I haven't heard the gong for a few days," Chiasson reports him saying.

Chiasson comes to Alsys after a four-year stint at Computervision Corp., Bedford, Mass, where he most recently served as vice president for the Mechanical Systems Division. Earlier, he worked for four years at Automatic Data Processing Inc., Clifton, N. J., and before that he spent 10 years at Xerox Corp.

A mechanical engineer by training, Chiasson worked on the backpacks used by astronauts on the moon while at Hamilton Standard, a division of United Aircraft Corp. He received his engineering degree from the University of Massachusetts and holds an MBA from Clark University, Worcester, Mass.

In management style, Chiasson describes himself as a "delegator." After assembling a talented team and assigning them as often as possible to things they like to do, he believes a corporate leader's job is to remove any obstacles so that work can proceed. "I'm not a bureaucrat," says Chiasson. "I get my high from working with people. If you get too big you lose that contact with people." *–Craig D. Rose*

NEW PRODUCTS

FASTEST PROGRAMMABLE LOGIC HAS 10-NS PROPAGATION DELAY

MONOLITHIC MEMORIES' PAL WILL COMPETE WITH ADVANCED SCHOTTKY

Monolithic Memories is bringing to market the fastest bipolar programmable logic devices yet. Parts in the PAL20D series feature 10-ns propagation delays—2 ns faster than parts introduced recently by Texas Instruments Inc. and 5 ns faster than Fairchild Semiconductor Corp.'s new Fastpla family [*Electronics*, April 7, 1986, p. 57].

The speed comes from a 1.5-μm walled-base oxide-isolation process, which the company says it will use in designing 7.5-ns devices to be available next year. It will also apply the technology to its 24-pin Programmable Array Logic (PAL) devices.

The series' 10-ns propagation delay (55.5-MHz maximum output-register toggle frequency) increases speed by 33% over Monolithic Memories' 15-ns 20B series without raising power consumption: both the 20B and 20D series dissipate 180 mA. TI's parts have a 200-mA rating. The 20D series is functionally compatible with the company's earlier 20, 20A, and 20B PAL families, and the programming algorithm remains the same.

Until now, the company's fastest PALs were its 15-ns 20B series, fabricated in a 2-μm junction-isolated process with implanted transistors; Steve Donovan, product marketing manager, attributes the 20B's performance to good design techniques. TI had to use its inherently faster Impact oxide-isolated process to reach 12 ns.

"Better design techniques enabled Monolithic Memories to achieve that speed from the slower junction-isolated process," says Donovan. "If the process is not coupled with good design techniques, then you don't get the benefits of that process."

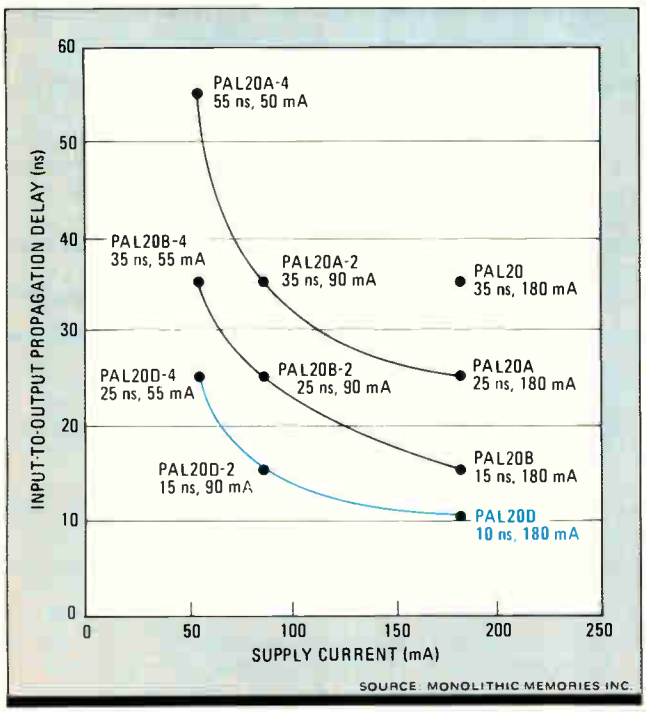
SCHOTTKY RIVAL. "PALs have always been like PacMen, gobbling up standard, discrete, small- and medium-scale integrated logic," says Donovan. "But now PALs can effectively compete with advanced Schottky processes like Fairchild's FAST." Both have about 3-ns equivalent gate delays, but the PALs offer greater density because each is typically used to replace two or three MSI devices. In addition, Donovan points out, system-level speed improves because, with fewer separate chips, there is less interdevice delay. The PALs are suitable for high-speed graphics systems, for example, and automatic test equipment.

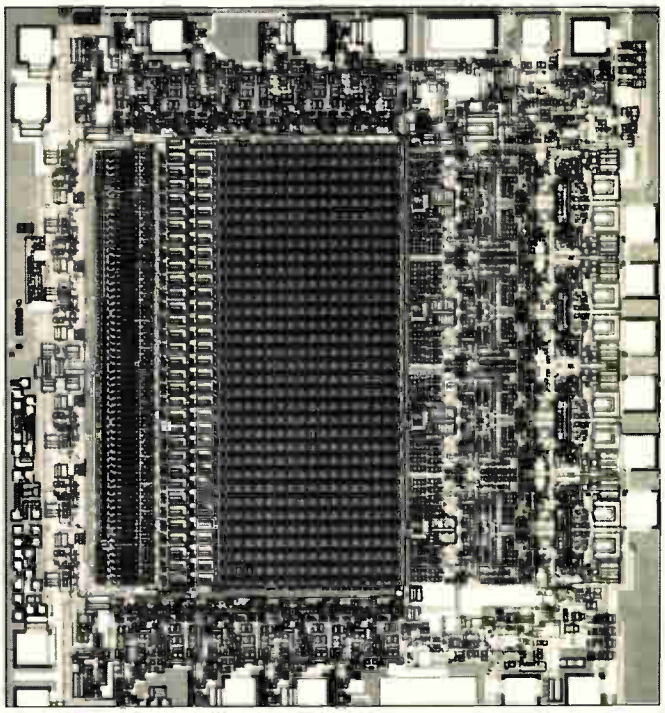
Another benefit of switching to the oxide-isolated process is a 90% decrease in input and output capacitance.

The PAL20D series includes the four standard 20-pin PAL architectures. All four devices have 16 array inputs and 8 outputs, with varying numbers of registers. The 16R8 has eight registers, the 16R6 has six, the 16R4 four, and the 16L8 none.

The combinatorial outputs on the registered devices and six of the outputs on the 16L8 are I/O pins that can be individually programmed as inputs or outputs. Each output register, a D-type flip-flop, feeds back into the array, suiting it for synchronous state-machine designs.

The registered outputs are controlled by an external input, while the combina-





PERFORMANCE CURVE. Monolithic Memories' switch to an oxide-isolated process reduced feature size and cut internal capacitances in its Programmable Array Logic family. The new family further improves the speed/power performance.

torial outputs use a product term to control the enable function.

The PAL20D series is programmable on the same standard programmers as the rest of the 20-pin PALs, and the PALs are supported by Palasm, Abel, and Cupl logic-development software packages from Monolithic Memories, Data I/O, and Assisted Technology, respectively. Once a PAL is programmed and verified, the user can blow two additional fuses, creating a circuit that is very difficult to copy.

In lots of 100 pieces, the PALs are priced at $8.35 each in plastic DIPs and plastic leaded chip carriers. Samples are available now, with production to start in June.

As with its other PAL series, Monolithic Memories will produce versions of the 20D series with varying speed and power specifications: 25-ns parts rated at 55 mA and 15-ns models rated at 90 mA. These will be available in the fourth quarter. *–Steve Zollo*

Monolithic Memories Inc., 2175 Mission College Blvd., Santa Clara, Calif. 95054. Phone (408) 970-9700 [Circle reader service number 338]

WANG SAYS ITS MINI OUTRUNS MICROVAX

Wang Laboratories is extending its VS line of minicomputers downward onto MicroVAX II turf. One of the company's two new low-end computers, called the VS 5 and VS 6, is base-priced lower than the fast-selling MicroVAX II from Digital Equipment Corp., and the other is comparably priced. Wang claims they're both significantly faster than the MicroVAXs for their intended applications, integrated office applications. The VS 5 and VS 6 are base-priced at $12,000 and $19,500, respectively, compared with the $19,000 starting price of the MicroVAX II.

PAPER WORK. Wang's VS 5 and VS 6 are priced lower than the MicroVAX but are faster for their target application: office automation.

Designed for use in small businesses and departments, the 32-bit machines can be installed by customers and fit under desks. Wang says the machines are up to 1.5 times faster than the MicroVAX II in transaction processing, up to two times faster for applications such as electronic mail, and up to three times faster in pure text processing. The MicroVAX II is rated at just under 1 million instructions/s. Wang won't give mips figures, but a Gartner Group survey pegs the VS 65, which has the same CPU as the VS 6, at 0.7 mips.

DEDICATED BUS. Wang points out that office-automation tasks are more I/O-intensive than scientific processing and that its computers excel in office automation because they have a microprocessor-controlled bus that is dedicated to I/O functions. The bus processor is built around a 16-bit 80186 microprocessor and includes a loadable control memory and a local memory to support peripherals. The bus processor also integrates several ports, including the Small Computer System Interface, into a single board.

The VS 6 can support up to 16 users and a total of 24 peripherals. To speed processing, the machine has 16-K bytes of cache memory, which cuts the average instruction-execution time to 200 ns. The architecture also enables the CPU to call the next instruction while executing a current instruction. The standard configuration includes 1 megabyte of main memory, a 67-megabyte Winchester disk drive, and a 1.2-megabyte floppy-disk drive.

The computer has facilities for attaching up to 2.48 gigabytes of external disk storage, and its main memory can be expanded to 4 megabtyes. The machine is fundamentally a reimplentation of Wang's much larger VS 65 computer, which is a 40-user system.

The VS 5 is similar to the VS 6, but without the cache memory. It has an average instruction-execution time of 480 ns and supports up to eight users and a total of 16 peripheral devices. Its main memory is expandable to 2 megabytes.

The systems are compatible with other members of Wang's VS line of computers and support network-management services. In addition, both support a number of Wang's integrated information-processing applications, such as its data-base management and word-processing packages. The two new computers are available now. *–Craig D. Rose*

Wang Laboratories Inc., 1 Industrial Ave., Lowell, Mass. 01851.
Phone (617) 459-5000 [Circle 341]

MOTOR DRIVER CHIP CLAIMS 98% EFFICIENCY

SGS Microelettronica SpA, Italy's principal semiconductor component maker, will soon deliver samples of its first ICs fabricated in a new three-technology process that offers a rare combination of low- and high-voltage devices on the same chip. The first circuit is a highly efficient H-bridge motor driver, designated the L6202. Samples will begin shipping by the end of this month.

SGS bases the circuit on its 60-V Multiwatt BCD technology [*Electronics Week*, Dec. 10, 1984, p. 28], a process that combines bipolar-linear, CMOS, and double-diffused MOS (D-MOS) power devices on a single chip.

The first customer to reap the advantages of this innovative technology will be Ing. C. Olivetti & Co., SGS's northern Italian neighbor, which helped design

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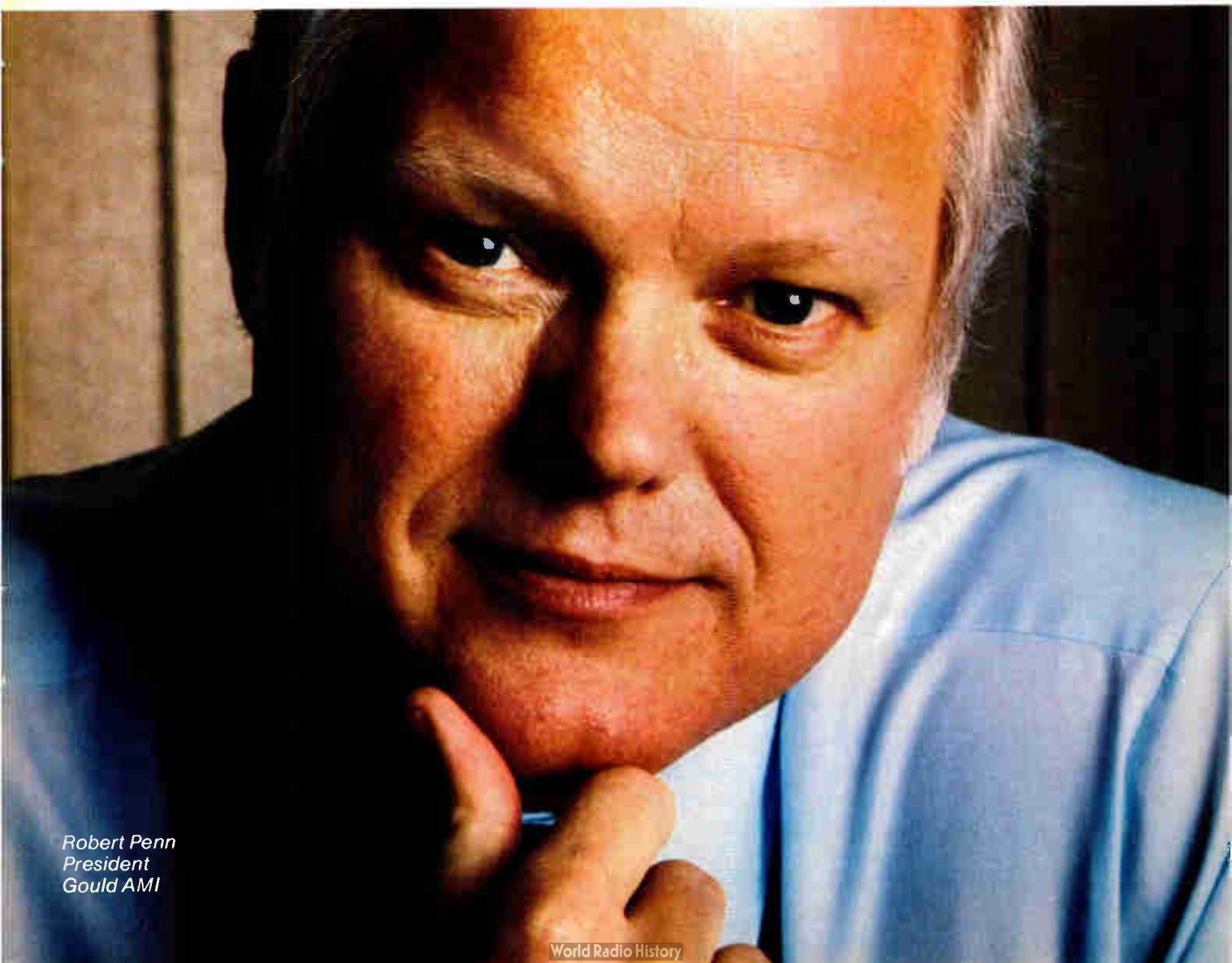

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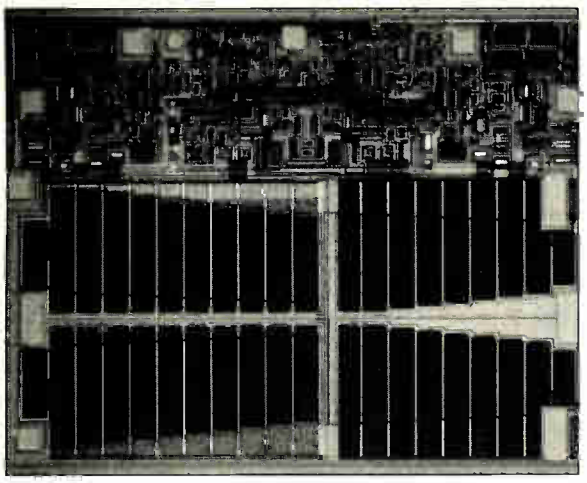

EFFICIENCY. SGS's motor-control IC boasts 98% efficiency, thanks to a combination of three process technologies.

ucts fall. The circuit can be used for dc- and stepper-motor driving; one chip drives either a dc motor or one phase of a bipolar stepper motor. Two thirds of the chip's real estate is taken up by a four-transistor D-MOS output stage, with each transistor consisting of hundreds of elementary D-MOS transistors. The other third of the silicon is devoted to control logic.

The principal advantage of the L6202 is its efficiency, a figure SGS sets officially at "higher than 90%" for the Multiwatt BCD technology. But for this particular circuit, which dissipates only 1.5 W while delivering 70 W to the load and 1.5 A of output current, efficiency is rated at 98%.

As a result of the low dissipation, the IC can be housed in a DIP and mounted in equipment without a heat sink. This simplifies pc-board design and makes the part ideal for automatic board assembly. These advantages are the main motivation behind Olivetti's interest in the technology.

The L6202 integrates control inputs that are compatible with all standard CMOS-logic and TTL families and furnishes an external connection to the lower drains for the current-sensing resistors necessary for constant-current chopper drives. The chip will also be available in a second version, the L6203, which delivers 3 A of output current.

The L6203 will be delivered in a Multiwatt package and will require a compact heat sink. SGS has set the price of the L6202 at $3 apiece in large quantities. *–Robert T. Gallagher*

SGS Microelettronica SpA, Via C. Olivetti 2, 20041 Agrate Brianza, Italy.
Phone (39-39) 65551 [Circle 339]

the first circuit. Olivetti will be chalking up substantial savings in production costs on its extensive line of electronic typewriters and printers.

The L6202 is the most sophisticated and complex mixed-technology IC on the market, according to Aldo Romano, director of SGS's Application Specific Integrated Circuit division, under whose aegis most of the company's bipolar prod-

IMAGE PROCESSOR BEATS 'REAL TIME'

Imaging Technology's Series 151 image processor works in 27 ms—faster than real time as defined by industry and RS-170 standards, which specify that an entire frame be processed in 33.3 ms. In addition, the system boosts processing speed by offering users the ability to selectively process only a portion of an image. The company implements in hardware a feature called area-of-interest processing, which lets users define and process an image's subregion at a 10-MHz pixel rate.

"The Series 151 is the first personal computer-based image-processing subsystem with the high performance required for many applications," says Robert Birenbaum, marketing director at the Woburn, Mass., company. Applications include machine vision and medical imaging.

The area-of-interest mode scans pixels inside the subregion and ignores those outside. One fourth of an image, for example, can be processed in 8 ms.

VMEBUS BASED. The system is built around a VMEbus and links with the IBM Corp. Personal Computer AT. The Series 151 includes three or four boards connected to the PC AT by a proprietary interface that gives the personal computer control of subsystem operation. The FB-150 frame-buffer board has three separate memories for frame storage: one organized as 512 by 512 by 16 bits and two as 512 by 512 by 8 bits.

The ADI-150, an analog-to-digital interface board, links the Series 151 to standard RS-170 and International Radio Consultative Committee (50-Hz) cameras. It includes an 8-bit flash analog-to-

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Bruce Bourbon
VP, Marketing
Gould AMI

digital converter providing digitization of 256 gray levels and 16 lookup tables. The board's output sections have 16 output lookup tables per color for pseudocolor display.

The ALU-150 pipeline processor handles fundamental image processing, and users can add the optional RTC-150 real-time convolver board to accelerate operations. The RTC-150 performs convolutions on matrices of 4 by 4, 3 by 3, and 16 by 1 pixels. The board hits 340 million operations/s in area-of-interest mode, the company says, running convolutions 60% faster than competing systems.

The Series 151, including software, costs $11,495 for the three-board version. The RTC-150 convolution-board option sells for $3,995. *–Debra Michals*

Imaging Technology Inc. 600 W. Cummings Park, Woburn, Mass. 01801.
Phone (617) 938-8444 [Circle 342]

VIDEO DAC CHIP HAS INTEGRATED RAM

Designed for high-performance graphics, the Bt451 Ramdac offers operating speeds up to 125 MHz. The Bt451 integrates three 4-bit digital-to-analog converters plus a dual-port 256-by-12-bit color-palette RAM on a monolithic CMOS chip. Because shift registers are also located on the chip, it can be connected directly to the frame buffer, eliminating external ECL shift registers.

The internal 256-by-12-bit, dual-port color lookup table supports up to 259 colors at a time—256 from the lookup table and three from the on-chip overlay palette—out of 4,096 possible colors.

Operating in the commercial temperature range, the Bt415 comes in an 84-pin grid array package. In quantities of 1,000, the 125-MHz version sells for $105, the 100-MHz version for $92, and the 75-MHz version for $79. Samples are available now.

Brooktree Corp., 9950 Barnes Canyon Rd., San Diego, Calif. 92121.
Phone (619) 452-7580 [Circle 350]

GRAPHICS STATIONS HAVE 45-NS WRITE TIME

Two models are being added to CGX Corp.'s 2030 color raster series of graphics work stations—the 2033 model 1A and the 2033 model 2. Among their features are a 45-ns pixel-write time and a 2.5-megabyte system memory.

A feature called supercheck lets the user identify and quickly fix occurrences of coincident, intersecting, or overlapping geometries in a design. Programmable function keys boost system productivity, the company says.

The work stations can be hooked up

to IBM Corp. 370, 43XX, and 30XX mainframe-based installations. Field upgrades to already-installed systems are possible.

The 1A is available now for $19,400; the 2, which will be delivered in May, goes for $20,900. The company offers discounts for volume purchases.

CGX Corp., 43 Nagog Park, Acton, Mass. 01720. Phone (617) 263-3222 [Circle 354]

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MEETINGS

CUSTOM IC MEETING ZEROS IN ON CAD

The topic getting the most attention at the Custom Integrated Circuits Conference in Rochester, N. Y., is computer-aided design. Nine sessions on CAD will double last year's five. The remaining 14 sessions cover such topics as surface-mounting, silicon compilers, and gallium arsenide IC manufacturing.

CAD use is growing because there are "many more model-based techniques," says Richard W. Bryant, technical program chairman and vice president of Ford Microelectronics Inc., Colorado Springs. The Georgia Institute of Technology will sort out the latest developments and trends on the use of CAD design for analog ICs. The paper also examines problems in adapting digital IC design tools to analog IC design.

Though he readily admits that "work stations are becoming more pervasive" for design of custom ICs, Bryant takes exception to the idea that breadboarding is dead. A panel session titled "Breadboarding vs. Logic Simulation" will explore views of those who say it is dead and those who see it as very much alive.

One session on compilers will feature a paper describing "an intelligent silicon compiler." The paper details how the unit translates behavioral descriptions and user needs into standard cells.

The session on GaAs IC manufacturing will have a more nuts-and-bolts orientation than last year's more theoretical session. This time, "people will see a rapidly maturing technology because papers are more factually supported and include examples."

One of the most interesting papers to Bryant will delve into surface-mounting technology and reliability for very large-scale-integration packages. In it, Texas Instruments Inc. will discuss "approaches to reconcile large bar size, small package geometry, high input/output, high power dissipation, and inexpensive material constraints." It will also discuss a board-assembly technique that uses a unique solder-paste formulation.

A recurring theme at the meeting will be the interrelationship between testing and packaging as a problem area for VLSI, Bryant says. "An untestable, yet working, chip is still not worth very much," he says.

CICC: Custom Integrated Circuits Conference, IEEE (Tom Foxall, Pacific Microcircuits Ltd., 240 H St., Blaine, Wash. 98230), Riverside Convention Center, Rochester, N. Y., May 12-15.

Computer Standards Conference 1986, IEEE Computer Society (1730 Massachusetts Ave., N. W., Washington, D. C. 20036-1903), Sheraton Palace Hotel, San Francisco, May 13-15.

Electro/86, Mini/Micro Northeast, IEEE and Electronic Representatives Association (Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, Calif. 90045), Bayside Exposition Center and World Trade Center, Boston, May 13-15.

Opto 86: 6th European Optoelectronics Conference, ESI Publications (General Secretariat, ESI Publications, 12, rue de Seine, 75006 Paris, France), Palais des Congrès, Paris, May 13-15.

CAT '86: Computer-Aided Technologies in Manufacturing, World Computer Graphics Association Inc. (2033 M St., N. W., Suite 399, Washington, D. C. 20036), Conference Center, Stuttgart, West Germany, May 13-16.

Information Management Exposition & Conference, Cahners Exposition Group (999 Summer St., Stamford, Conn. 06905), Los Angeles Convention Center, Los Angeles, May 14-16.

Carnahan Conference on Security Technology, IEEE (University of Kentucky, College of Engineering, Office of Engineering Continuing Education, Lexington, Ky. 40506-0043), Carnahan House, University of Kentucky, Lexington, May 14-16.

Computer III: Establishing a Regulatory Framework, Phillips Publishing Inc. (7811 Montrose Rd., Potomac, Md. 20854), Marriott Crystal Gateway Hotel, Arlington, Va., May 15-16.

Inspection, Repair, and Protection of Photomasks and Reticles, Semiconductor Equipment and Materials Institute Inc. (625 Ellis St., Mountain View, Calif. 94043), Villa Hotel, San Mateo, Calif., May 15-16.

Information Everywhere, Information Industry Association (P. O. Box 76480, Washington, D. C. 20013-6480), Fairmont Hotel, Denver, May 19-21.

Pack-Tronics '86: 1st International Conference & Exhibition on Protective Packaging for Electronic Products (Schotland Business Research Inc., Princeton Corporate Center, 3 Independence Way, Princeton, N. J. 08540), Boston Marriott Burlington Hotel, Burlington, Mass., May 19-21.

Computer Standards Conference, IEEE Computer Society (1730 Massachusetts Ave. N. W., Washington, D. C. 20036), Renaissance Hotel, San Francisco, May 20-22.

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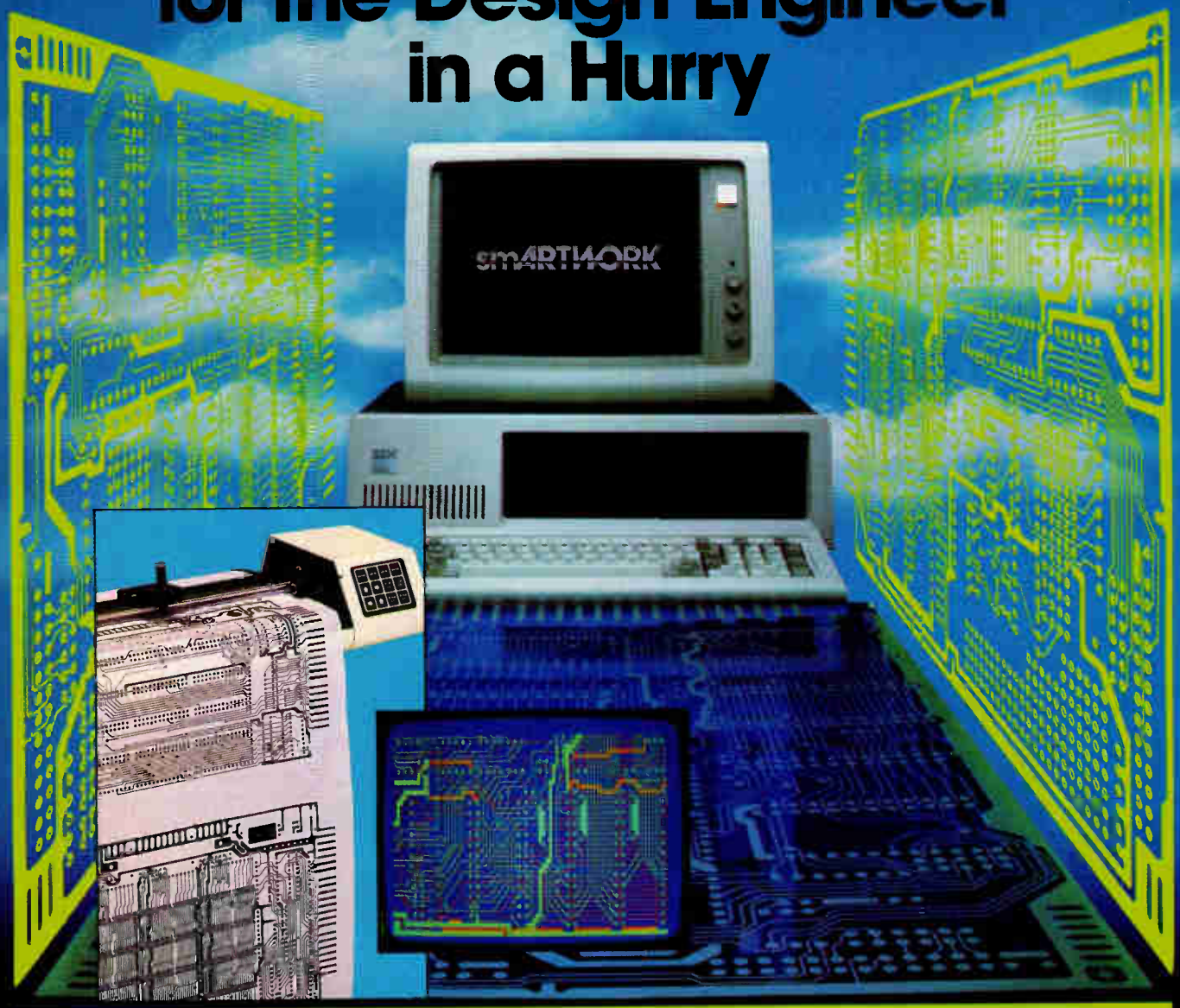

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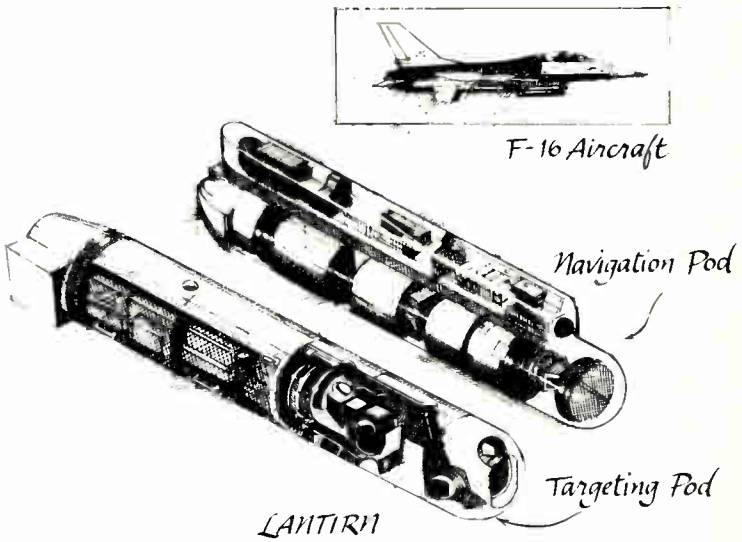

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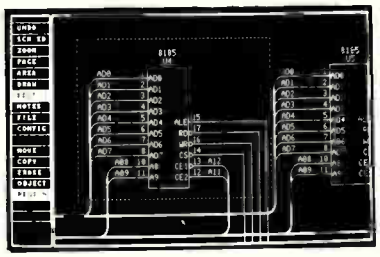

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ELECTRONICS WEEK

ENCORE STARTS SELLING PRODUCTS

Encore Computer Corp. has sold seven of its Unix-based Multimax multiprocessor systems to customers including universities and Argonne National Laboratory. The Marlboro, Mass., company began life in 1983 with an industry all-star team but failed to sell even one computer system until this year. Encore also has sold its software subsidiary, Foundation Computer Systems Inc. of Cary, N. C., to Sperry Corp.

NTT SEEKS OK FOR AIR PHONE

Nippon Telegraph & Telephone Corp. is expected to receive quick approval from Japan's minister of posts and telecommunications for its plan to offer airplane telephone service, which could begin as early as the end of the month. The service, which will be for outgoing calls only, will initially be available on the 80 largest-capacity airplanes of Japan's three major airlines serving domestic routes. Airline phone service has been in trial operation in the U. S. for 18 months [*Electronics Week*, Dec. 10, 1984, p. 17].

BOOK-TO-BILL RATIO CONTINUES CLIMB

The semiconductor recovery continued in March, says the Semiconductor Industry Association, as the book-to-bill ratio rose to 1.15, a 21-month high and the seventh consecutive monthly increase. March bookings were 26.7% over those of March 1985, and 58% more than the September 1985 low point.

SINCLAIR SELLS COMPUTER ASSETS

Sir Clive Sinclair has sold the personal computer activities of Sinclair Research Ltd. to UK compatriot Amstrad Consumer Electronics plc for just over $7 million. Those activities produced some 90% of Sinclair's revenues in 1985, so the sale effectively closes down the company that all but created the European home computer business. Plagued through much of its history by production and stock-control problems, Sinclair had been in serious financial difficulties for more than a year. Most industry sources consider the price a bargain.

VARIAN UNCOVERS OVERCHARGES

An internally initiated investigation at Varian Associates has revealed that engineering hours may have been inaccurately reported to the government, which may have resulted in overcharges, according to a spokesman. The Palo Alto company says the inquiry involves a small number of employees in the Microwave Tube Division working on government purchase orders prior to late 1983. The inquiry, which has been going on for a number of weeks, is directed by Varian's legal department.

UCCEL TO BUY BIG SOFTWARE FIRM

In the biggest step yet of its year-long efforts to refocus products on more profitable businesses, Uccel Corp. of Dallas will acquire an as-yet-unnamed "$100 million to $200 million" software house. Within the past year, Uccel, which specializes in mainframe software and financial applications, has made a series of smaller mergers, buying up more than a half dozen software companies.

OLIVETTI MAY BUY TRIUMPH-ADLER

Though neither company will officially confirm or deny the reports, industry sources say Ing. C. Olivetti & C. is very close to agreement on a deal that would give it control of Volkswagen AG's troubled office-equipment subsidiary, Triumph-Adler. The move would be the latest and most ambitious in a program of acquisitions by Italy's foremost producer of office-automation and data-processing equipment, which last year led to the purchase of Great Britain's ailing Acorn Computer Group plc.

HEWLETT DONATES $50 MILLION

William R. Hewlett, who cofounded Hewlett-Packard Co. with David Packard in 1939, has pledged $50 million to his alma mater, Stanford University—the largest commitment from one person the school has ever received. Most of the money—$40 million—is earmarked for redevelopment of Stanford's research facilities into a new science and engineering commons. The rest of the Hewlett funds will be used to attract matching grants.

ARIANE SELECTED BY JAPANESE

The Paris-based Arianspace Co. has been picked by one of two new Japanese satellite communications ventures, Space Communications Corp., to handle two launches set for 1988. It has made an advance payment of $200,000 to reserve space. Space Communications, owned by Mitsubishi Electric Corp., has agreed to purchase the satellites, each with 35 transponders, from Ford Aerospace & Communications Corp.

ITT, AUSTRIA START R&D CENTER

ITT Corp. and the Austrian state-owned enterprise Elin have established a research center in Vienna for work in basic system components. Goals include the development of fault-tolerant computer systems, software design methods, real-time programming languages for telecommunications and process control, and the application of artificial intelligence. Starting in temporary quarters and employing 30 people, the center is expected to employ 70 scientists within three years, and to have moved into its own facility. Funds will come from Elin, ITT and its Austrian subsidiary, and from government research contracts.

ASHTON-TATE TO MARKET JAVELIN

Ashton-Tate Co., the Torrance, Calif., supplier of microcomputer software, and Javelin Software Corp., a Cambridge, Mass., software developer, have signed a major joint-marketing agreement. Ashton-Tate has agreed to sell in overseas markets Javelin's business analysis software package, which is also called Javelin. Ashton-Tate executive vice president Ron Posner said the agreement lets his company add "a major plank" to its product line, while giving Javelin access to overseas markets without the financial overhead of setting up its own distribution operation.

INTEL REPORTS QUARTER LOSS

"We think the first quarter was the bottom of the cycle," said Intel Corp. president Andrew S. Grove as he reported a net loss of $22 million for the period. This compares with net income of $11 million for the same period last year. Grove offered two reasons for Intel's poor showing for the quarter ending March 29. IBM Corp., the Santa Clara, Calif., company's largest customer, worked off inventory and bought less, and there was unusually strong demand for selected systems products in the fourth quarter. Grove also noted that prices appear to be firming in many areas, particularly memories, which were hit hardest in 1985.

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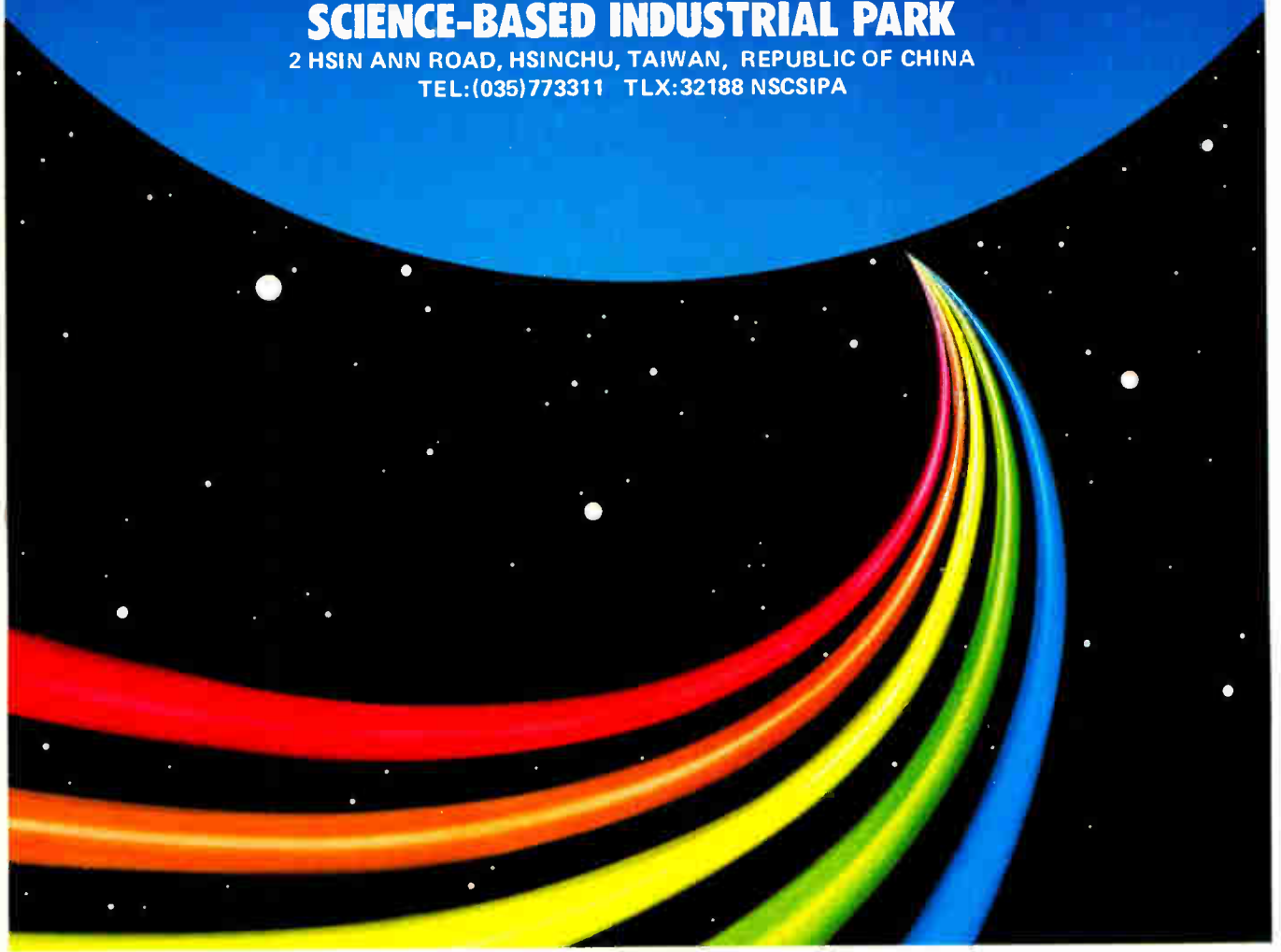

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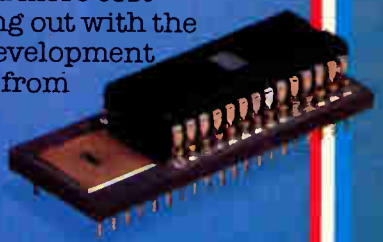

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