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Wang Laboratories

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## WANG'S NEW 3300 The First "BASIC" Time Sharing System Under \$20,000

The 3300 is a time sharing mini-computer system for only  $\frac{1}{4}$  the cost of subscription services or other in-house time sharing systems. That, in itself, is very therapeutic. And any anxieties about communicating with a computer can be eliminated by BASIC. The popular conversational language, ideal for beginners and experts alike. It's simple to get involved with a 3300. Begin a system with just one terminal if you like. Then add hardware as needed to accommodate up to 16 users, or to broaden system capability. It's truly mind expanding.

 **WANG** LABORATORIES, INC.

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# Wang Labs enters mini-computer market

Time-sharing 3300 BASIC stores programs on standard magnetic tape cassettes

Wang Laboratories, Inc., Tewksbury, Mass., has gone into the computer business. First product of the new venture is a time-sharing mini-computer, the Wang 3300. Wang, a major U.S. maker of programable electronic calculators, says that its Wang 3300 BASIC system—which can accommodate as many as 16 users simultaneously—was designed to fill “the growing gap between expensive time-sharing terminals and our most powerful desk top calculators.”

The firm claims that the 3300 BASIC, with prices starting at \$15,250, is “the lowest cost and most easily operated mini-computer time-sharing system available.” The system uses modified IBM Selectric typewriters as primary input/output (I/O) devices, but can also work with standard teletypewriter terminals. Programs are stored on standard magnetic tape cassettes, with high-speed disk storage soon to be available as an extra-cost option.

Heart of the system is the Wang 3300 central processing unit, an eight-bit general-purpose computer which uses TTL (transistor-to-transistor logic) integrated circuits and MSI (medium scale integration) circuitry techniques. It has a standard 4096-word, 1.6-microsecond full-cycle memory, expandable to 65,536 words.

Most mini-computers have only three to 10 index registers, Wang says, but the 3300's core memory incorporates a push-up/pop-down indirect addressing system which allows the entire core to serve as index registers. This mode of address not only enhances programing efficiency, the maker states, but also enables the 3300 to execute programs previously considered impossible for eight-bit computers.

**Repertoire.** The Wang 3300 has a repertoire of 72 instructions, including 21 memory reference instructions with both single and double byte operands. There are also five single and double arithmetic instructions which operate in either binary or decimal mode. Although the 3300 is nominally an eight-bit computer, use of double memory reference and arithmetic instructions provides instruction logic equivalent to that of many 16-bit machines, Wang claims.

## Wang 3300 uses BASIC software

### Verb repertoire:

COM	GOSUB	PRINT
DATA	GOTO	READ
DEF	IF	REM
DIM	INPUT	RESTORE
END	LET	RETURN
FOR	NEXT	STOP
TRACE		

### Function library:

SIN	LOG	SGN
COS	ABS	AND
TAN	SQR	OR
ATN	INT	BOOL
EXP	RND	

### Command repertoire:

LIST	RERUN	START
¢*	LOAD	RESTART
RUN	SAVE	

\* Partial statement correction.

Wang offers a choice of I/O devices. Standard teletypewriter terminals are the least expensive. Or, for higher speed (15 characters per second) and quieter operation, Wang will furnish its own I/O writer consisting of a modified IBM Selectric typewriter with character buffer and BASIC-

compatible character set. As many as 16 I/O terminals can be connected to the system. With teletypewriter terminal and an acoustic coupler, the computer can be operated from remote locations over standard telephone lines.

**Cassettes.** For secondary storage with the I/O writer, Wang has developed a high-speed (300 characters per second) tape cassette driver capable of operating two magnetic tape cassettes (the same kind used for audio purposes). Wang says that the magnetic tape cassettes offer a combination of compactness, ease of storage and handling, low cost, and durability unmatched by any other storage device. A single system may contain multiple cassette drivers.

For users who require still greater storage, several disk storage devices, including a low-cost 65,536-word disk and a high-speed 0.5-megabyte disk, will be available soon. There are few restrictions on the use of these high transfer rate peripherals, the firm says, since the central processor design permits I/O direct memory access cycle stealing between instruction execution subcycles.

Software for the 3300 uses the BASIC language (see box). BASIC was chosen, the company says, after marketing field studies indicated that BASIC was the most popular conversational time-sharing language. The

Wang 3300 BASIC uses either standard teletypewriters or modified IBM Selectric typewriters for input/output, accepts as many as 16 simultaneous users

similarities of BASIC to everyday English make it simple, Wang asserts, for even the beginner to accomplish significant programing results during his first hour at the terminal.

**Simulator.** Wang engineers developed the software with an IBM 360/65 simulator while still working on the hardware.

“By using simulators,” software applications manager Bob Kolk says, “we not only completed software development on an accelerated schedule, we also noted some unique characteristics that later were incorporated into the hardware design.”

The company claims several advantages for its version of BASIC:

- An “immediate” mode converts the BASIC system to a conversational calculator. Entry of an unnumbered BASIC statement causes immediate execution, even during a program operation.

- System save and load commands allow the user to store and load BASIC programs conveniently on cassette tapes, thus permit him to accumulate library programs without costly disk allocations.

- Floating point format is used for all variables, with eight digits of rounded decimal precision. Data may have exponents between  $10^{-63}$  and  $10^{63}$ . Arithmetic calculations are performed in decimal mode. Boolean logic functions are included.

- Several terminal entry and diagnostic features make for convenient operation. Diagnostic error messages point to the exact column in the BASIC statement where the error was detected. Syntax diagnostic messages are printed immediately after each line entry. A small change command (¢) permits correction of one or more columns in a statement without re-typing the entire statement, and also permits copying existing statements with new statement numbers. The user may stop program execution and system output at any time by pressing the ATTENTION key on the terminal.

- Several provisions are made for user program checkout. Trace on and OFF are incorporated as BASIC statement verbs to permit selected traces. A RERUN command permits program execution starting in the middle of the program, with current variable values maintained.

- Compiler design makes optimum use of user partition area for text and tables. Except for ultimate partition size, there are no physical restrictions on the number of allowable nested loops, nested subroutine calls, or nested functions. Partition size is modularly expandable, as are the verb, command, and function repertoires.

- Provision for common data allocation (COM) allows each user to retain variables between chained programs and make more efficient use of his allocated core space.

Standard support software such as assembler, loader, and diagnostics are available without extra charge to the 3300 purchaser. Complete applications systems software will be furnished for an initial charge and a monthly use and maintenance charge.

**Library.** A standard accessory of the 3300 BASIC system is a program library abstract service, which lists programs written and maintained for the system. System users can buy these library programs on tape cassettes “at a nominal cost,” Wang says. Programs are available in the fields of mathematics, statistics, business, finance, physics, chemistry, mechanics, electronics, thermodynamics, struc-

tures, surveying, and games. An extra dividend, Wang points out, is the extensive BASIC software developed in the past five years.

System prices begin at \$15,250 for a central processor and two teletypewriter terminals. Most comparable in-house time-sharing systems would cost about \$65,000, Wang says. For less than \$20,000, the firm adds, a user can purchase the central processor, several terminals, cassettes, and “all the software needed to get started.” Or, he could lease the same package for less than \$600 a month.

“The 3300 system was designed to be used for computing answers, not process control,” says Wang’s marketing manager John Cunningham. “Initially, our market will be people who otherwise would have to use a calculator or a terminal.” According to Wang, marketing studies have indicated potential customers in high schools, junior colleges and small universities, individual departments of larger universities, and engineering and research departments of both small and large corporations. Primary areas of concentration will be in statistics, mathematics, engineering, finance, biomedicine, and the sciences.

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## Time-Sharing Minicomputer Designed Around Software



Wang 3300 Basic

By Frank Piasta

CW Staff Writer

TEWKSBURY, Mass. — The Wang 3300 Basic, a low-cost time-sharing computer system, was tailored during development to accommodate software requirements, according to Wang Laboratories Inc.

The software packages for the system were developed by PHI Computer Services, a subsidiary of Wang, by simulating the 3300 on an IBM 360/65. Some of the problems encountered were solved by the novel approach of changing the hardware design, the firm said.

As its name implies, the 3300 Basic uses the Basic time-sharing language as the prime means of communications. This results in what Wang calls “the most easily operated minicomputer time-sharing system available.”

The central processor, an eight-bit computer called the Wang 3300, features 1.6  $\mu$ sec cycle memory. From a minimum of 12K words, the 3300 is expandable in 4K increments to a maximum of 65K words. A repertoire of 70 instructions and over 20 memory reference commands include decimal and binary arithmetic capabilities.

Also featured in the processing unit are

*(Continued to Last Page)*

# Computer has calculator price tag

Eight-bit time-sharing system aimed at in-house applications serves 16 users simultaneously, performs decimal arithmetic

By James Brinton

Electronics staff

When the price and capability of a company's products bump the bottom of the next higher order of machine, there's a strong likelihood that a new line will evolve. Wang Laboratories Inc., long a major competitor in the calculator field, pushed its programable machines upward into the minicomputer market, both in price and capability. Its model 700 was less a calculator than a microprogramed, time-sharing, special-purpose computer.

So it should surprise no one that the firm is now going to market with an 8-bit computer system capable of handling up to 16 users simultaneously. And, though the model 3300 is aimed at engineering, scientific, and industrial applications, its software library includes programs that make it a true general-purpose computer.

Though the move was a simple extension of its market, Wang looked before it leaped into design. The company's market researchers found that:

▶ Almost 75% of the tasks demanded of a costly time-sharing system could be performed with a calculator; but users were willing to pay for that extra 25% flexibility gained by time-sharing.

▶ Despite all the programming languages available, more than 40% of users adopted Basic because of its simplicity and similarity to mathematical expression.

▶ Most time-sharing users were paying an average of \$9 to \$11 per hour for port time—plus costs for telephone lines, and storage of programs and data bases. The lowest rate was about \$5 per hour.

The 3300 system is designed to sell at a price low enough to fit



**Time-sharer.** Computer for in-house systems uses Basic language for scientific, engineering, and commercial applications.

the in-house time-sharing market, competing effectively with service bureaus. The 3300 costs \$15,250 up. It also competes in price with other in-house time-sharing systems like those built around the PDP-8L, which at about \$20,000 minimum is the lowest priced of Wang's competitors, though it serves fewer users.

Beyond this point, costs escalate; the time sharing PDP-8I runs from about \$40,000 upward, and typical systems built around Hewlett-Packard's HP-2000 cost about \$80,000 minimum.

In a four-user configuration, the 3300 costs \$21,250. This, in effect, prices each of its teletypewriter terminals at \$5,312.50. Hewlett-Packard's HP-9100 programable calculator costs \$4,400—plus \$975 for a companion printer—for a total of \$5,375. Wang's model 700 costs a basic \$4,900. Thus a time-sharing

general-purpose computer system can cost less per terminal than a set of calculators.

Leasing a 3300 system for less than \$600 monthly, a user will pay only about 75 to 80 cents per hour for port time, estimates John F. Cunningham, 3300 marketing manager. "That's a tenth the cost of service bureau time," he says, "and there are no telephone or other charges to add." Thus, Cunningham claims, the 3300 is a good buy even though its data storage capabilities are more limited than those of a service bureau, and its overall capabilities—like those of other in-house systems—encompass only 50-60% of a service bureau operations.

Finally, the 3300 system uses a modified Basic that permits the user to do mathematical operations as easily as with a calculator, to use a teletypewriter or Selectric output as a stand-in for a plotter,

and perform business-oriented operations, as well. Wang already has on the shelf about 200 calculation programs and expects to add another 200 to 250 soon, covering 50 "unique disciplines," Cunningham says.

Wang's software is "unbundled." The company charges a \$1,500 fee for the Basic compiler and for system setup. Thereafter, users pay \$10 per month per terminal to cover the cost of a program library maintenance and updating program. Robert S. Kolk, software applications manager, says that the availability of up-to-date, relevant programs has been a shortcoming of other in-house time sharing systems, and the library policy should circumvent it. Users are to be mailed a list of the library's contents regularly, and the programs themselves are to be available at from \$5 to \$10 per cassette. "We just want to ask enough to pay for labor and materials," says Kolk.

**Unique?** The 3300 can do both binary and decimal arithmetic, something perhaps unique in mini-computers. Kolk says the decimal capability allows computations more accurate than those possible with 16-bit computers operating at double precision.

Wang stores numbers in five byte locations, one giving binary notation, and the other four bytes each storing two decimal digits. "We're willing to pay the premium in core space this costs us in return for the increased accuracy," says Kolk.

But Wang's use of memory probably makes the penalty easy to bear. Core expands from the basic system's 12,288 words in 4,096 increments to a total of 65,536—twice the amount possible with most minicomputers.

For second level storage, Wang plans to offer disks as well as its present cassette deck line. A dual cassette deck is offered for use with the 3300 at \$1,400; pricing hasn't been set for the disk system, although it is said to be patterned after the fluidically controlled DDR-1 of the Digital Information Storage Corp. of Berlin, Mass. [*Electronics*, Oct. 13, 1969, p. 149].

**Close fit.** The 3300's cpu is a simple-seeming mainframe which manages to accomplish fairly impressive tasks through its close fit

with the Basic software package. The processor appears to be small; it has only one accumulator register, a single accumulator extension register, and one addressable status register, for example. But, in its handling of lists, loops, and nested subroutines, it is more like DEC's PDP-11 in that all its core addresses are open for use as temporary registers—and up to 65K of core can be accommodated.

Also, though the processor is an 8-bit machine, it is said that use of double memory reference and arithmetic instructions provide instruction logic equivalent to that found in many 16-bit machines.

Its addressing modes include immediate addressing that lets the cpu shift into a calculator emulation mode when the Basic line number is omitted, and indirect addressing, which allows auto-incrementing, auto-decrementing, and push-down stack uses with either 1- or 2-byte instructions.

Accenting the simplicity of software operation are features like automatic error detection: if an error in syntax, or an illegal operation or an overflow appears, the next line printed out points to the exact location of the error in the statement above and tells its column number and the type of error made. Also, the user can put more than one Basic statement on a line; the 3300 saves them as entered for ultimate execution. In addition, statements can be easily corrected: if the user catches his own error, he can backspace to erase it, or—using the appropriate symbols—selectively correct individual characters within a statement.

**Built-in check.** Perhaps most important to the new or inexperienced user is the Trace feature built into the 3300 system. The Trace mode allows the computer to follow the programmer through his entries. Also, whenever a variable receives a new value during program execution, the Tracer mode reads back data. This read-back ability proves useful when a program transfer is made to another sequence of statements, such as when the computer is diverted to a new subroutine by Fortran-like IF-THEN, or GO-TO branching commands.

Delivery is 90 to 120 days.

Wang Laboratories Inc., 836 North St., Tewksbury, Mass. 01876

## EQUIPMENT & EDP

Edited by PHILLIP BROOKE

### Wang Labs Offers Low-Cost Mini-Computer Time Sharing System—Model 3300 BASIC

TEWKSBURY, Mass. — Wang Laboratories Inc. has introduced what it calls the lowest cost and most easily operated mini-computer time sharing system on the market today.

Billed as the Model 3300 BASIC, the Wang system begins at \$15,250 for a central processor and two teletype terminals, including BASIC, compared to approximately \$50,000 for other low cost time-sharing systems.

Extending the features of the highly popular and simple BASIC language, the Wang system accommodates any number of terminals up to sixteen. With the Wang Model 1103A acoustic coupler, the user may operate from remote locations using the Wang 3315 Teletype terminal and standard telephone lines.

The central processor, an 8-bit computer called the Wang 3300, features 1.6 microsecond full cycle memory in 4K units expandable to 65K, and decimal arithmetic, a repertoire of 70 instructions, over 20 memory reference instructions, push/pop addressing system, both character bus and direct memory access I/O, and priority interrupt, the company says.

Unlike most manufacturers, Wang offers a choice of terminals. For greatest economy, the user may select standard teletype terminals as input-output devices, but Wang also developed a 15 character per second I/O writer; this is a modified typewriter with character buffer and BASIC compatible character set. The high speed, excellent reliability and low noise levels of typewriters, combine efficiency and simplicity in the Wang terminals. For secondary storage with the I/O writer, Wang developed a special high tape cassette driver capable of operating two magnetic tape cassettes. Magnetic tape cassettes combine compactness, ease of storage and handling, low cost and durability unmatched by any other storage device. A single system may combine multiple cassette drivers. Anyone requiring still greater storage, however, may expect several disk storage devices from Wang in the near future.

Aside from the uniqueness of the total system, the Wang 3300 possesses several features that make it stand alone even as a mini-computer, the company states.

For example, the Wang 3300 incorporates a push up/pop down addressing system in the core memory. This means that, unlike most mini-computers with only 3 to 10 index registers, the entire 3300 core serves as in-

dex register, thus conserving program steps, eliminating saves and stores, and increasing programming efficiency.

The addition of double memory reference commands lets the Wang 3300 readily execute programs previously considered impossible for an 8-bit computer. The Wang 3300 offers both the standard binary arithmetic for internal computations and a decimal mode for eliminating base conversions, again enhancing program efficiency. Most systems utilize only binary mode.

A list of special memory instructions represents another hardware feature of the Wang 3300. With over 20 memory reference instructions, the inexpensive 3300 central processor handles sophisticated software such as the BASIC language. Most similar systems have only 5 to 10 memory reference instructions.

Software for the 3300 is the popular and easily learned BASIC language. Wang engineers developed the software with a 360/65 simulator while still perfecting the hardware. By using the simulator, Wang not only completed the software on an accelerated schedule, but also realized major engineering cost savings. The savings, in turn, are passed on to customers in a singularly low cost system that offers full computer power. Other software features include powerful debugging and plotting commands.

The Immediate Mode feature of the software enables the user to have the computer function as a powerful desktop calculator. By simply omitting a line number from the BASIC command, the operator automatically switches the computer into this mode of instant execution and generates an immediate response. Since the Wang 3300 system allows multiple statements on a line, the user may run sophisticated calculations without writing an entire program.

The Wang 3300 not only incorporates state of the art features found in most BASIC systems, but introduces several others.

"Aside from the actual hardware and software features, the choice of terminals, expandability of the system, ease of operation and computing power make the Wang 3300 BASIC the most sophisticated and least expensive time-sharing system available today," a Wang spokesman says.

For further information contact: Wang Laboratories, Inc., 836 North Street, Tewksbury, Mass. 01876.

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## THE WANG 3300 BASIC SYSTEM

*Will 1970 be "The Year of the In-House Time-Sharing System?"*

Having initiated 1970 by extolling the virtues of shared in-house BASIC systems, we were fully prepared to wager that another half-dozen or so of these systems (presently ranging from \$40K to \$60K for a 4-terminal configuration; providing for up to 12 additional terminals at \$1500 — \$3000 per) were already "on the pike" and scheduled for announcement by the fall (FJCC) of this year. Our expectations were based on our beliefs that 1. the market is "clear and present"; 2. the field is wide-open competitively (at the time we knew of only two systems which were being actively marketed); 3. the state-of-the-art is well within realization; and 4. \$40K-\$60K is not unreasonable for a flexible BASIC system geared to handle up to 16 user terminals.

So much for our expectations. As of this month, Wang Laboratories, Inc. will offer an up-to-16-terminal BASIC system that will sell in the \$25K range for a typical 4-user configuration, including Selectric terminals and cassette drives. As a result, while we are even more convinced that 1970 will be "The Year of the In-House Time-Sharing System," we have revised downwards our expectations as to the number of companies that will be offering competing systems in the near (12 month) future.

### HARDWARE

The heart of Wang's Time-Sharing System is a spanking-new 4K-64K (bytes), 1.6 usec. processor designated the Wang 3300. In its minimum 4K configuration, the TTL/MSI 3300 sells for \$4,950, making it the first g-p mini priced under \$5K. Add-on memory modules are available in 4K increments for \$2,500.

These low prices in large part reflect Wang's choice of an 8-bit word, but the decision to use a smaller word size has had proportionately little effect on performance. An extensive repertoire of 72 instructions includes 20 for memory reference alone and five single and double arithmetic instructions which operate in either binary or decimal mode. Instruction logic is therefore equivalent to many 16-bit machines. Additional hardware instruction features include a complete and compatible set of bus and channel I/O, interrupt, and skip instructions; the ability to permit I/O direct memory access cycle-stealing between instruction execution sub-cycles; and a unique, push-pop auto-incrementing and decrementing indirect addressing feature throughout memory for both single and double instructions.

A standard 3300 time-sharing configuration consists of one 4K processor (\$4,950); two additional 4K core units (\$5,000); two Selectric I/O terminals (\$4,200); a terminal control unit (\$500 — controls up to four Selectrics); a pair of magnetic tape cassette drives

(\$1,400); and the BASIC software package which includes a one-time set-up and initialization fee (\$1,500). Total: \$17,550. Assuming individual terminal users are content with 1400-byte partitions (partition size is determined at set-up time), a 4-user Selectric/cassette system would cost \$25,650. Two- and four-user TTY systems are priced at \$15,250 and \$21,250. Goodies include an acoustic coupler (\$795) for use with the TTYs, and still-to-be-priced 65K and 1/2-megabyte disks.



The WANG 3300 — The CP of Wang Labs' new T-S system.

### SOFTWARE

Since the BASIC compiler was simulated on an S/360-65 while the hardware was still in development, the resulting system has all the advantages of a happy hardware/software marriage. Significant features of Wang BASIC are:

- An "Immediate Mode" — unnumbered BASIC statements are immediately executed in calculator fashion.
- A "Diagnostic Pointer" and "Trace Mode" — for debugging and error checking.
- Common Data Allocation — variables can be retained between chained programs to allow more efficient use of allocated core.
- BASIC PRIME and TAB extensions — for plotting functions.
- Terminal Convenience Features — such as the ability to save and load programs via high-speed cassette tapes, and to modify and copy statements on a character basis.

These features, along with Boolean logic functions, unlimited subroutines, and a full 8 digits of decimal ac-

curacy (data may have exponents between  $10^{-63}$  and  $10^{63}$ ) should be more than enough to handle the needs of most present time-sharing users.

### SUPPORT

Wang is certainly geared to produce, sell, and support these turnkey systems. The company is a most efficient manufacturer (last year Wang generated over \$23 million in revenue with only 55,000 sq. ft. of plant space; an additional 85,000 sq. ft. facility is under construction), and has an excellent sales and marketing track record in the desk-top calculator field. In addition to what the company already provides in its extensive BASIC program library, Wang can draw upon the resources of Philip Hankins Inc., acquired in 1968, for systems and programming support.

Dr. An Wang, the company's president and treasurer, summed-up Wang Laboratories' capabilities and support philosophy very neatly: "As the leader in sophisticated calculators, it was logical to enter the small computer market. We have our traditional strength in hardware, an excellent software group, and an extensive field sales and service organization. Not only can we develop a total system, we can also support the user." We don't doubt it.

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### COMPUTERS

#### low-cost minicomputer provides time-sharing

THAT THERE IS A GAP in pricing and performance between programable desk-top calculators and expensive time-sharing systems is known to most researchers looking for a modest system. One of the leaders in the calculator field may have filled that gap by designing the first time-sharing minicomputer.

The step up to a minicomputer is a small step for Wang Laboratories Inc. (Tewksbury, Mass.) but could be an important jump for many research facilities with this type of intermediate need in computing power.

Industrial Research has learned that the central processor and two teletype terminals will cost \$15,250, which compares favorably with most systems costing \$65,000. Up to 16 in-house or telephone-remote users may operate simultaneously using the popular BASIC language.

Heart of the system is the 3300 digital computer that offers a sophisticated instruction and input/output capability. An 8-bit machine, expandable in 4,000 units up to 65,000 of 1.6- $\mu$ sec core, the 3300 has a reper-

toire of 70 instructions, over 20 memory reference instructions, and several other features common only to more expensive systems.

The BASIC language was chosen after Wang market research showed it to be the most popular conversational time-sharing language. Included in the software package are: an immediate



SOMETHING TO FILL THE GAP  
the Wang 3300 central processor

mode that can give each user the capability of a desk-top calculator, a "diagnostic pointer" that debugs and provides error checking, a common data allocation that allows each user to retain variables between chained programs, BASIC print and tap extensions



#### Low-Cost Time-Sharing System Introduced

New general purpose microcircuit digital computer developed by Wang Laboratories, Inc., is the heart of a low-cost time-sharing system designed to fill the gap between desk-top calculators and large-scale time-sharing systems. The central processor shown above, designated the Wang 3300, is an 8-bit machine, offering 1.6-microsec. full cycle memory in 4K units, expandable to 65K, binary and decimal arithmetic, a repertoire of 70 instructions and a choice of input/output terminals. Standard Teletype 33ASR units may be used for input/output stations, and Wang also offers a 15 character/sec. modified typewriter with character buffer and basic language compatible character set.

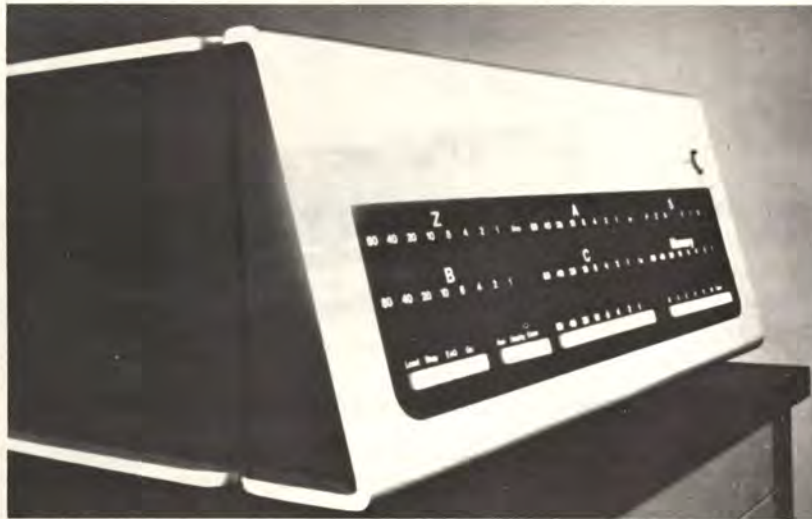
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for plotting functions, and terminal convenience features that can save and load programs via high-speed cassette tapes.

Current terminal equipment for the 3300 system includes a 15 CPS modified typewriter with character buffer and BASIC compatible character set. In addition, there is an acoustic couple modem for phone line terminal hook-up. In the future, Wang expects to add a low-cost 65,000 disk and a high-speed 0.5 megabyte disk.

Among options that can further aid users are the program library abstract service, which lists programs written and maintained for the system and complete applications systems software. □

*Reprinted from Industrial Research, February 1970; copyright Industrial Research, Inc., 1970.*



**mini time-sharing**

Now one of the big calculator manufacturers has crossed over the thin line and built a mini time-sharing system based on a real live computer, the Model 3300. A byte machine, the 3300 uses an 8-bit word size which can be expanded by double precision software, a core memory with a 1.6 usec cycle time which can be ordered in sizes from 4K bytes to 65K, built-in binary and decimal arithmetic, a 72-instruction set with 21 memory reference commands, a push-down/pop-up address scheme, and a direct memory access channel.

Input stations are IBM Selectric I/O writers or ASR 33 Teletypes, and the cpu and its time-sharing executive can handle up to 16 of them. (Response times are expected to be in the two to five second range for up to eight simultaneous users running "average" t-s programs.) A standard part of each terminal is a dual magnetic tape cassette drive rated at 300 cps. Acoustic couplers are offered as options, and two discs, one 65K low cost unit and one .5 megabyte high speed unit, will soon make an appearance in the product line.

The 3300 is set up with an 8-bit accumulator, an 8-bit accumulator extension, an 8-bit addressable status register, and the claimed ability to use every byte of core as an index register. The designers also claim that double memory reference and arithmetic instructions give the 3300 instruction logic equivalent to "many" 16-bit computers. Five modes of addressing are used, including: in page, absolute (page 0 or page 1), immediate, and indirect.

The system's speeds are given as 6.4 usec for a 16-bit binary or BCD add (4.8 usec for 8-bit words), better than 300kc for the transfer rate of the dma.

The 3300 is intended for commercial dp use. Its primary language is BASIC. Extensions to the compiler have been incorporated to provide for an "Immediate Execution" mode (giving one user complete control, this is also called "Calculator" mode), multiple instructions per line, COMMON data areas, 8-digit floating-point accuracy (with exponents from  $10^{63}$  to  $10^{63}$ ), diagnostics, a program trace, and unlimited nesting.

Other software furnished includes an assembler, a source tape editor, a debug package, loader and iocs, and diagnostic routines. There is a charge for BASIC and other applications systems like it, and for applications programs such as the BASIC statistical package.

Like anything else, the cost of a time-sharing system should be figured by how much work is done per dollar. Because of its relatively low cost, the 3300 should show up fairly well in such calculations. A two terminal Selectric/cassette system runs \$17,550. If the buyer chooses the Teletype-based configuration without cassettes, the price falls to \$15,250. Additional Selectrics run \$2100, tty's are \$1750, and the cassette drives (which will be Newell's in the first systems) will go for \$1400. Couplers go for \$795 each, and there is a \$1500 charge for the BASIC compiler and system set-up (plus a maintenance cost for the compiler). WANG LABORATORIES, INC., Tewksbury, Mass. For information:

**Time-Sharing Minicomputer Designed Around Software**

*(Continued from Page 3)*

a push-down stack addressing system that permits every core position to be used as an index register, priority interrupt, or both character bus and direct memory access I/O, according to Wang.

At the present time, peripheral units are limited to terminals, of which several are offered. The most economical unit is the teletypewriter terminal. A 15 char/sec I/O writer, a modified Selectric typewriter with character buffer and Basic-compatible character set, is also available.

For secondary storage with the I/O writer, Wang developed a high-speed tape cassette drive capable of operating two magnetic tape cassettes. The Wang 1103A acoustic coupler may be used with the Wang 3315 Teletype terminal over standard telephone lines. A total of 16 terminals can be supported by one 3300 system.

Wang has indicated that a disk-storage device will be available for the 3300 in the near future. CW has learned that this will be a five-million byte system to be built by Digital Information Storage Corp. Wang is a part owner of this supplier. The disk units will probably be announced in about six months, according to Wang.

Other software available for the 3300 includes an assembler, and utility programs such as debugging aids; and printing and plotting routines.

A typical 3300 system, including a 12K processor, two teletypewriter terminals, and the Basic language, costs \$15,250.

First customer deliveries are scheduled for June 1970, and the system will then be available on a 120-day schedule, the company said.

Wang Laboratories Inc. are located at 836 North St.

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