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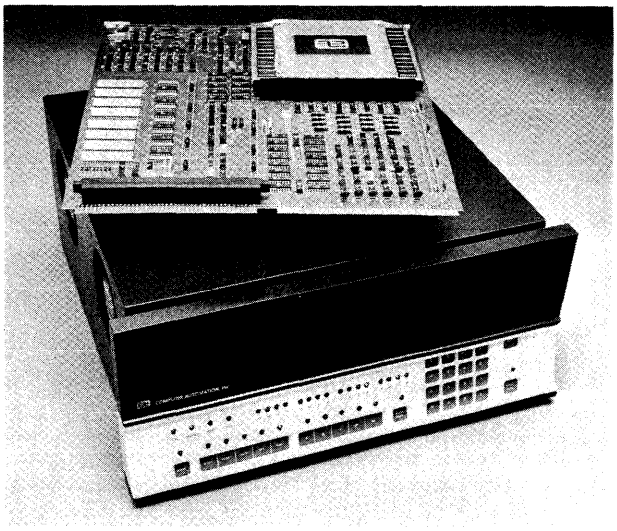
Computer Automation Naked Mini/Alpha 16 LSI



Fully compatible with each other, the 16-bit Naked Mini LSI "computer on a board" (above) with 8K words of memory, and its companion, the fully clothed LSI with up to 72K words of memory (in the chassis), are the latest in CAI's line of OEM minicomputers. Both models implement LSI technology, a powerful instruction repertoire, and unique packaging schemes to offer an exciting product to the OEM minicomputer systems market.

This pair of 16-bit OEM-oriented computers provides a powerful instruction repertoire in a low-cost "Naked" version without power supply or front panel so that OEM manufacturers can buy from Computer Automation just the required processing capability. A fully-clothed stand-alone minicomputer package is also available.

MANAGEMENT SUMMARY

The OEM-oriented Naked Mini and Alpha LSI systems are intended for use as components in larger systems, and the Naked Mini is available only in quantities of ten or more. Both systems were announced on May 1, 1973, and according to an established CAI pattern, the announcement was dramatic, offering the Naked Mini (CPU plus 4K of 16-bit words on a printed-circuit board, no power supply or chassis) for the barrier-breaking price of $990 in quantities of 200 or more.

This price was about half that of its lowest-priced competition at the time, and while industry price reductions (usually reflecting lower manufacturing costs) have somewhat eroded that gap and will continue to do so, CAI seems likely to improve the price-performance ratio once again by the time that their current edge is blunted.

The Alpha LSI—a Naked Mini board plus power supply, chassis, and operator console—sells for $1990 with 4K words of memory (in single-unit quantity). Up to 256K 16-bit words of core or MOS memory can be used with the Naked Mini/Alpha LSI.

Among the significant internal design aspects of the Naked Mini/Alpha LSI is the instruction repertoire. The instruction set has been designed to perform most of the computer's operations upon execution of a short, one- ▷

CHARACTERISTICS

MANUFACTURER: Computer Automation, Inc., 18651 Von Karman, Irvine, California 92664. Telephone (714) 833-8830.

MODELS: Alpha LSI and Naked Mini LSI.

DATA FORMATS

BASIC UNIT: 16-bit word (plus two optional parity bits per word for core memory only).

FIXED-POINT OPERANDS: Eight-bit bytes or 16-bit words. Bit manipulation instructions for variable-length operands of one-16 bits or variable length byte strings are also provided.

FLOATING POINT OPERANDS: Two-word or three-word formats through software subroutine only.

INSTRUCTIONS: One- or two-word instructions with 11 different formats: most of which are one-word types, with double word for several types. Single-word memory reference instructions have a four-bit operation code, an eight-bit address field (0-255), and indicator bits to specify direct/indirect address mode. Double-word memory reference instructions have a three-bit operation code, a four-bit instruction (iteration) count, a 15-bit operand address, and indicator bits to specify direct/indirect address mode, etc. Byte-Immediate instructions have a three-bit operation code, an eight-bit immediate operand, and five flag bits. Conditional jump instructions have a four-bit operation code, a six-bit jump distance (0-63 locations), a five-bit "microcode" field for a mask to indicate test conditions, and one bit to specify jump direction (forward/backword). Single-Register Shift and Register change instructions have an eight-bit operation that specifies source, operation, and location of results, a three-bit shift control count (zero for register change) and a five-bit instruction type indicator. The double-register shift instructions are similar to the single-register shifts except that the shift control count field is four bits and the operation code is seven bits.

Control instructions have a one-bit instruction type indicator, a seven-bit operation code, and an eight-bit halt or instruction counter. I/O instructions have a two-bit instruction type indicator, a six-bit operation code, a five-bit device address, and a three-bit function code. Block I/O instructions are similar to I/O types except for a three-bit instruction type indicator and an additional 15-bit base address field. Automatic I/O instructions use three words; the first of which has the same format as the I/O instruction, plus two additional words to hold a 15-bit ▶

Computer Automation Naked Mini/Alpha 16 LSI

word instruction (requiring a single-machine cycle). The nature of the instructions has also been given careful consideration with the result that numerous memory reference instructions are available (among the more than 150 instructions), including Exchange-Memory-And-A-Register, Memory-Scan, Three-Way-Compare, Double-Word-Normalize, and Multiply/Divide. Also, most of the memory reference instructions can operate in either a word mode or a byte mode for increased flexibility. Another design aspect of the Naked Mini/Alpha LSI that holds key significance for the user is the asynchronous MaxiBus I/O bus that permits the intermixing of core and MOS memory modules with different speeds in the same system.

Typical products or systems in which the company's computers have been employed include: key-to-disc data entry systems using multiple keyboards to enter data to magnetic storage discs and tapes ("shared processor" systems, such as General Computer Systems 2100); control and monitoring of automated welding machines (Weldtronic, Inc.); control of automatic bank teller devices designed to dispense cash and accept deposits (Docutel Corporation); monitoring of medical and other analytic instruments (Hycel, Inc.); and computer controlled machine tool systems (Entrekin). A CAPABLE digital logic module tester based upon the Alpha LSI is also available directly from CAI ($30K-$50K).

In keeping with the company's self-styled image as an OEM-oriented vendor, Computer Automation actively recommends that users purchase their peripherals directly from the peripheral vendor. However, an extensive variety of interfaces for most popular mini-peripherals is available, and Computer Automation will deliver peripherals on a package basis at the user's request. In fact, CAI makes no peripherals itself, and would prefer to do business with the processor/memory/interfaces only.

Competition for the two Computer Automation systems comes from the OEM versions of each major minicomputer manufacturer's product lines: DEC's PDP-11/05, Data General's Nova 2's, Interdata's Model 74, the General Automation SPC's, etc. While the Naked Mini/Alpha LSI is not quite as fast as some of these systems, the processors are fast enough for all but the heaviest processing requirements. In some applications, competition comes from the lightweight "micro" computers, such as Intel's MCS Families. In such competitive encounters, however, the microprocessors have distinct limits on speed, power, and peripheral availability. The only serious pressure applied to Computer Automation by the microprocessors is destined to be for low-cost applications where the Naked Mini/Alpha LSI (or any standard minicomputer), represents too much computer in the first place.

Computer Automation's reputation as a vendor is excellent, and customers who have purchased about 3,000

byte/word counter, and a 15-bit address pointer (start location). Direct addressability to the scratchpad (word/byte locations 0-255) or to 512 word/byte locations relative to the current instruction address. Addressing modes include direct (to scratchpad), relative (to current location), indexed, indexed thru scratchpad, indirect relative to current location, and indirect post indexed.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Core or MOS.

CYCLE TIME: 1.6 microseconds for core; 1.2 microseconds for MOS.

CAPACITY: 1,024 to 262,144 words, in 1K, 2K, or 4K modules for MOS; or 4K, 8K, or 16K modules for core. Up to 72K words can be contained in the basic mainframe (16K core boards), with external mounting through an optional additional chassis for additional memory modules. For expansion beyond 32K words, a Memory Banking feature is required. When more memory than can fit in the main chassis is present, five-slot memory module expansion chassis can be added.

CHECKING: Optional parity bit associated with each eight-bit byte for core only.

STORAGE PROTECTION: None.

RESERVED STORAGE: About 20 words of the scratchpad, or page "0" (first 256 words) are normally reserved for device/interrupt addresses; if desired, these reserved words can be put into page "1".

CENTRAL PROCESSOR

GENERAL: The Alpha LSI is a Naked Mini LSI board plus chassis, power supply, push-button operator's console (with non-mechanical switches and LED displays), and motherboard (for interconnection of additional I/O and memory modules). The Naked Mini LSI processor itself is contained on a single 15" x 17" printed-circuit (PC) board that includes the basic 1K to 8K words of memory, four processor chips (P-chips) and three control chips (C-chips).

Both types of chips are MOS/LSI P-Channel Silicon gate devices. The P-chip contains the arithmetic unit with carry lookahead, register file, status flip-flops (including overflow), and chip interface logic organized on a four-bit slice. Each C-chip contains a macro-instruction register with a four-bit count-down capability, a status inhibit counter, interrupt logic, part of a programmable logic array (PLA) or associative ROM, and PLA/micro-instruction conversion logic. The full PLA holds the microprogram store of the processor and consists of three C-chips with 20,400 memory bits. Each C-chip implements a subset of the instruction repertoire, and only one C-chip at a time is actively issuing microinstructions.

Standard features include multiply/divide, five vectored priority interrupts, and two direct memory and one DMA channels; optional features include power-fail/restart, real-time clock (0.1, 1.0, or 10.0 KHz), autoload, and the full-duplex teletype/CRT Interface. All of the options except the power fail/restart physically mount on a special piggyback option board; the power fail/restart option mounts on the main CPU board.

REGISTERS: Program accessible registers include a 16-bit accumulator (A), a 16-bit Index/Secondary accumulator

Computer Automation Naked Mini/Alpha 16 LSI

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	SPEED
MAGNETIC TAPE UNITS		
18240	Single or dual Drive Cassette, max 520 KB or storage, 12 ips, 800 bpi (1 slot)	75 words/sec
18224-10 (Pertec 7820)	Industry-compatible, 12.5 ips 9-track (800 bpi) read/write (1 slot)	10 KBS
18224-20 (Pertec 7840)	Industry-compatible, 12.5 ips 9-track (800 bpi) read-after-write (1 slot)	10 KBS
18224-30 (Pertec 6860)	Industry-compatible, 37.5 ips 9-track (800 bpi) read/write (1 slot)	30 KBS
18224-40 (Pertec 6840)	Industry-compatible, 37.5 ips 9-track (800 bpi) read-after-write (1 slot)	30 KBS
LINE PRINTER		
18223-30 (Centronics 101)	132-position, 64-character (1/2 slot)	165 cps
PUNCHED CARD EQUIPMENT		
18223-40 (Bridge 8000)	Reader, 80-column (1/2 slot)	300 cpm
PAPER TAPE EQUIPMENT		
18223-11 (Remex 305)	Reader (1/2 slot)	300 cps
18223-20 (Remex 1075)	Punch (1/2 slot)	75 cps
18223-60 (Remex 3075)	Reader/Punch (1 slot)	300/75 cps
TERMINALS		
22204-00 (Teletype ASR-33)	Hard copy, with paper tape read/punch (0 slots)	–
22204-10 (Teletype ASR-35)	Hard copy, with paper tape read/punch (0 slots)	–

Computer Automation minicomputers to date report a high degree of satisfaction with the products. □

Load/Store	7.0
Add/Subtract	9.2
Multiply/Divide	116.0/124.0
Compure and Branch	15.6

register (X), and one-bit flip-flop registers for overflow (OV), byte-mode operation (BM), and interrupt enable (IEF). Internal registers that are loaded as a result of user program execution include a one-bit status inhibit counter (SIR), and two one-bit flip-flops for power-fail interrupt enable (PEF) and console interrupt enable (CEF). Other registers include the 16-bit instruction register (I), 16-bit program counter (P), three 16-bit working registers (W,T,B), one-bit bitsave/carry flip-flop (BS), and a 16-bit Macro-instruction register (MIR).

INDIRECT ADDRESSING: Yes, to multiple levels for word mode, and to one level for byte mode.

INSTRUCTION REPERTOIRE: 168 basic instructions made up of 27 single-word memory reference instructions, three double-word memory reference instructions, ten byte-immediate instructions, 13 conditional jumps, 12 single-register shifts, four double-register shifts, 48 register change instructions, 18 control instructions, 27 I/O instructions, four automatic I/O instructions, and two block I/O instructions.

INSTRUCTION TIMINGS: All times are for full-word, fixed-point operands in microseconds.

INTERRUPTS: Five levels standard, providing two internal and three external. The third external level with control lines can optionally accommodate up to 256 vectored interrupts in increments of 16 (feature 13220).

CONTROL STORAGE: 256 16-bit words of ROM bootstrap control storage are available as an option for teletype, paper tape, magnetic tape, cassette, and disc.

INPUT/OUTPUT CONTROL

MAXIBUS: The MaxiBus provides five I/O systems with a total of 58 parallel lines. The systems are a high-speed block I/O, programmed I/O, conditional I/O, direct memory channels, and DMA. The standard block I/O feature allows I/O data transfer over the MaxiBus at 131,579 words/second; with programmed I/O, the maximum data rate is 34,247 words or bytes/second. Programmed I/O direct to memory is also possible at a rate of up to 24,631 words or bytes/second. The DMA provides cycle-stealing prioritized data transfer at up to 26,738 words/second under interrupt control, or up to 625,000 words or bytes/second in burst mode for a single memory bank (up to 1,250,000 with interleaved memories). Up to 128 direct memory channels

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are provided and a total of up to 248 I/O devices can be attached.

CONFIGURATION RULES: The basic Naked Mini LSI consists of one board and no chassis. The chassis (for use with Alpha LSI) has five slots, four of which are available for interfacing half- or full-size boards for peripheral/terminal devices (8½-size peripheral/terminal boards of 4 full-size memory boards). Each expansion chassis also has 5 full-size slots. Each memory module (after the basic increment of up to 8K words mounted on the CPU board) requires one slot position; general purpose I/O options require half a slot each; the asynchronous modem multiplexor requires one slot; and other communications interfaces require ½ slot. (See Mass Storage and Peripherals/Terminals Table for individual device slot requirements.)

MASS STORAGE

18520-43 MOVING HEAD DISC SYSTEM: Includes one fixed and one removable disc with 200 cylinders (2.46 million words) and interface for up to three additional 22520-43 drives. Average access time is 38 milliseconds (plus 12.5 milliseconds average rotational latency), and data transfer rate is 156,000 words per second. A double density version (18520-44/22520-44) stores up to 4.96 million 16-bit words per spindle on 400 cylinders. The interface and controller combined occupy two chassis slot positions.

18520-31 MOVING HEAD DISC SYSTEM: Includes one removable-disk drive with 200 cylinders (1.23 million words) and interface for up to three additional 22520-31 drives. Average access time is 70 milliseconds (plus 20 milliseconds average rotational latency), and data transfer rate is 97,000 words per second.

DIABLO MODEL 31 or 33 DISC DRIVES: An interface (14520-00) for up to four Model 31 or two Model 33 drives. Separate charges are made for supporting software (disc formatter, I/O drivers, diagnostic routine, file manager–$750) and checkout and integration of customer furnished drives ($1,000). The drives themselves are not available from Computer Automation, but can be obtained directly from Diablo.

INPUT/OUTPUT UNITS

Note: Computer Automation will supply paper tape equipment, a line printer, card readers, and magnetic tape/cassette drives, but recommends that the user purchase only the interface(s) from Computer Automation and the I/O devices directly from the OEM manufacturer. General purpose I/O interfaces for 16, 32, or 64-bit I/O modules are also available.

See also Peripherals/Terminals table

COMMUNICATIONS CONTROL

14227 ASYNCHRONOUS CONTROLLER: Provides single channel, full-duplex interface for Bell System 103 and 202 data sets with RS 232 or DTL interface. Occupies half-slot position.

14236 DUAL TERMINAL INTERFACE: Provides half-duplex interface for 2 CRT's, leased line modems, or ASR 33/35 teletypes (110-9600 bps). Occupies half-slot position.

14311 SYNCHRONOUS MODEM CONTROLLER: Provides double buffered full duplex interface for Model 201 data sets with speeds up to 50 KBS and RS 232 characteristics. Occupies half-slot position.

14512 ASYNCHRONOUS MODEM MULTIPLEXOR: Provides interface for two or four programmable lines at speeds from 75-9600 bps.

SOFTWARE

OPERATING SYSTEMS: Four operating systems are available for the Naked Mini or Alpha LSI, as is a basic paper tape "driven" system. All are separately priced as are the language processor. A Real-Time Executive (RTX) is offered as a modular system consisting of a multitasking executive, an I/O supervisor, a communications supervisor, and a real-time debugging program. RTX is designed to help the OEM user construct real-time application programs. A full Disk Operating System (DOS) is available to operate from Disc, Magnetic Tape (MTDS) or Cassette (COS). DOS (or its various media counterparts) is a device-independent, batch-oriented system that supports program development as well as providing automatic control or job sequencing, I/O, interrupt handling, library support, file management, and on-line operator communication.

PROGRAMMING: The user has a choice of three two-pass assemblers (Beta 4, 4K, Beta 8, 8K, and Omega, 8K), three levels of BASIC (advanced, 4K, Extended, 8K, Extended multiple-user, 16K), and ANS FORTRAN for program development. (The FORTRAN compiler is not supported by Computer Automation, it is available only "as is".) A Cross Assembler (XASM) written in FORTRAN IV Level G is also available for use on IBM System/360 or 370 systems.

APPLICATIONS: A limited number of basic utilities and program development aids are available, but the user must develop his own applications programs.

PRICING

POLICY: Computer Automation provides the Naked Mini LSI for sale only in quantities of 10 or more units. (Alpha is available in single unit quantities.) As a strictly OEM-oriented company, Computer Automation also recommends that buyers deal direct with other vendors for peripheral/terminal equipment, but will provide certain units if desired. Most software is separately priced, as are all elements of the system that are not necessarily required by the OEM buyer.

SUPPORT: The amount of field support provided depends strictly upon individual negotiations and is related directly to the purchase quantity. Computer Automation provides system support from 15 U.S. locations, as well as 13 other offices worldwide. The processor(s) is covered by a one-year warranty, and the peripherals (if obtained through Computer Automation) are under a 30-day warranty. Separate set-up and check-out charges are made for peripherals not supplied directly by Computer Automation.

On-site Maintenance is generally the responsibility of the user, and can be performed rather easily through simple replacement of the board involved. Toward that end, users generally keep a supply of spares on hand.

Computer Automation also provides one-week programming/maintenance training courses for $250 per man/week. An education allowance of $50 per system is associated with the purchase of an LSI machine.

EQUIPMENT: A typical system delivered by Computer Automation is a 4K-word Naked Mini LSI with real-time

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clock, autoload, 16-bit I/O module, and 16-channel priority interrupts. Purchase price is $2315.

A typical Alpha LSI, with 4K words, power fail/restart, teletype interface and auto load costs $2,455. ■

EQUIPMENT PRICES

		Purchase Price
NAKED MINI/LSI PROCESSOR		
10110-01	Processor plus 1K words semiconductor	$ 990
10110-02	Processor plus 2K words semiconductor	1,125
10110-04	Processor plus 4K words semiconductor	1,200
10100-04	Processor plus 4K words core	1,650
10100-08	Processor plus 8K words core	2,200
10100-16	Processor plus 16K words core	4,300
ALPHA/LSI PROCESSOR		
10210-01	Processor plus 1 K words semiconductor	1,780
10210-02	Processor plus 2K words semiconductor	1,915
10210-04	Processor plus 4K words semiconductor	1,990
10200-04	Processor plus 4K words core	2,400
10200-08	Processor plus 8K words core	2,990
10200-16	Processor plus 16K words core	5,090
10201-04	Processor plus 4K words core (parity)	2,890
10201-08	Processor plus 8K words core (parity)	3,590
10201-16	Processor plus 16K core (parity)	6,290
MEMORY/PROCESSOR OPTIONS		
11530-01	1K words semiconductor	930
11530-02	2K words semiconductor	1,100
11530-04	4K words semiconductor	1,500
11510-04	4K words core	1,750
11510-08	8K words core	2,300
11511-04	4K words core (parity)	2,200
11511-08	8K words core (parity)	2,900
12500-00	Power Fail Restart (PFR)	250
12505-01	Interface/mounting for all processor options except PFR	150
12505-02	Teletype interface	100
12505-04	Real Time Clock	125
12505-08	Autoload Bootstrap Loader	90
12505-16	EIA RS 232 interface for CRT console	15
13220-00	16 channel priority interrupt	500
12034-00	Basic chassis for Naked Mini	275
12907	Expansion chassis for Alpha (5 slots)	500
12044	Power Supply for Naked Mini or 12907	325
12098	Battery pack for semiconductor power failure	150
MASS STORAGE		
18520-43	Disc and control, 2.46 million words	13,200
22520-43	Add-on Drive	11,085
18520-44	Double Density Disc and Control, 4.96 million words	15,800
22520-44	Add-on Drive	12,885
18520-31	Disc and control, 1.23 million words	11,450
22520-31	Add-on Drive	9,300
14520-31	Diablo 31/33 Control Only	2,400
MAGNETIC TAPE EQUIPMENT		
18240-01	Cassette and control, 75 words/sec	2,850
18240-02	Dual cassette and control	4,550
22240-01	Add-on drive	2,275
22240-02	Dual Add-on drives	3,975
18224-10	Drive and control, 18 KBS	7,000
22224-10	Add-on Drive	4,380
18224-20	Drive and control, 10 KBS	7,600
22224-20	Add-on Drive	4,970
18224-30	Drive and control, 30 KBS	8,900
22224-30	Add-on drive	6,300
MAGNETIC TAPE EQUIPMENT		
18224-40	Drive and Control, 30 KBS	9,400
22224-40	Add-on Drive	6,800
14224-00	Control only for 22224-10, -20, -30, -40	2,400

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EQUIPMENT PRICES

		Purchase Price
PUNCHED CARD EQUIPMENT		
18223-40	Reader and control, 300 cpm	$3,850
14223-00	Control only	600
PAPER TAPE EQUIPMENT		
18223-11	Reader and control, 300 cps	2,430
14223-00	Control only	600
18223-20	Punch and control, 75 cps	3,780
14223-00	Control only	600
18223-60	Reader/Punch, 300/75 cps	5,790
14223-00	Control only	1,200
PRINTER		
18223-30	Printer and control, 165 cps	5,550
14223-00	Control only	600
INTERFACES		
13213-00	16-bit I/O Module	500
13214-00	32-bit Output Module	750
13215-00	32-bit Input Module	750
13216-00	64-bit Output Module	500
13219-00	64-bit Input Module	500
13222-00	I/O Driver Module	500
14223-00	Utility I/O Interface	600
COMMUNICATIONS		
14227-1	Asynchronous Control (RS 232C)	650
14227-3	Asynchronous Control (DTL)	625
14236-1	Dual Interface (RT-modem)	575
14231-21	Dual Interface (ASR 33/35)	500
14236-5	Dual Interface (CRT-ASR)	575
14311-00	Synchronous Controller	1,200
14512-2	Asynchronous Multiplexer, 2-line	850
14512-4	Asynchronous Multiplexor, 4-line	1,200
TERMINALS		
22204-00	ASR-33 with paper tape reader/punch	1,400
22204-10	ASR-35 with paper tape reader/punch	4,800
22204-30	ASR-33 with paper tape Reader/punch (programmed on/off)	1,580

SOFTWARE PRICES

20025/20026	Documentation/Basic paper tape Program Library (one set for each of first six systems at no charge)	$150
19001	Basic/Advanced, or extended, or multiple user), ten-year license	300
19004	XASM Cross Assembler for S/360 or S/370	200
19005	RTX Real Time Executive	300
19007	DOS, or MTDS, or COS Operating Systems	2,000

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clock, autoload, 16-bit I/O module, and 16-channel priority interrupts. Purchase price for the Type 2 is $3,550.

A typical Alpha LSI Type 1, with 4K words of semiconductor memory, power fail/restart, teletype interface, and auto load costs $2,515. ■

EQUIPMENT PRICES

		Purchase Price
NAKED MINI PROCESSORS (TYPE 1/TYPE 2)		
LSI-1		
10110-01	Processor plus 1K words semiconductor memory (1600 nanosec.)	$ 985
10110-02	Processor plus 2K words semiconductor memory (1600 nanosec.)	1,125
10110-04	Processor plus 4K words semiconductor memory (1600 nanosec.)	1,200
10120-04	Processor plus 4K words core memory (1600 nanosec.)	1,650
10120-08	Processor plus 8K words core memory (1600 nanosec.)	2,020
10160-16	Processor plus 16K words core memory (1200 nanosec.)	3,200
LSI-2		
NOTE:	Naked Mini/LSI-2 and Alpha/LSI-2 central processors are upward compatible with LSI-1 processors from an electrical, mechanical, and programming standpoint, but they execute programs faster. They have the same basic 168 major instructions, with hardware multiply/divide, double-word normalize, memory scan, and byte capability. Additionally, however, the Type 2 machines have an Extended Instruction Set, numbering 20, for unlimited memory stacking that the Type 1's do not.	
10440-04	Processor plus 4K words core memory (1600 nanosec.)	2,150
10440-08	Processor plus 8K words core memory (1600 nanosec.)	2,495
10450-04	Processor plus 4K words core memory (980 nanosec.)	2,200
10450-08	Processor plus 8K words core memory (980 nanosec.)	2,545
10460-16	Processor plus 16K words core memory (1200 nanosec.)	3,675
ALPHA PROCESSORS (TYPE 1/TYPE 2)		
LSI-1		
10210 01	Processor plus 1K words semiconductor memory (1600 nanosec.)	1,780
10210-02	Processor plus 2K words semiconductor memory (1600 nanosec.)	1,915
10210 04	Processor plus 4K words semiconductor memory (1600 nanosec.)	1,990
10220 04	Processor plus 4K words core memory (1600 nanosec.)	2,440
10220 08	Processor plus 8K words core memory (1600 nanosec.)	2,810
10260 16	Processor plus 16K words core memory (1200 nanosec.)	3,990
10241 04	Processor plus 4K words core (parity, 1600 nanosec.)	2,890
10241 08	Processor plus 8K words core (parity, 1600 nanosec.)	3,590
10261 16	Processor plus 16K words core (parity)	6,290
LSI-2		
10540 04	Processor plus 4K words core memory (1600 nanosec.)	2,665
10540 08	Processor plus 8K words core memory (1600 nanosec.)	3,010
10550 04	Processor plus 4K words core memory (980 nanosec.)	2,715
10550 08	Processor plus 8K words core memory (980 nanosec.)	3,060
10560 16	Processor plus 16K words core memory (1200 nanosec.)	4,190
MEMORY/PROCESSOR OPTIONS		
11530-01*	1K words semiconductor, 1200 nanosec. cycle	930
11530-02*	2K words semiconductor, 1200 nanosec. cycle	1,100
11530 04	4K words semiconductor, 1200 nanosec. cycle	1,500
11540 04	4K words core, 1600 nanosec. cycle	1,525
11540 08	8K words core, 1600 nanosec. cycle	1,650
11541 04*	4K words core, 980 nanosec. cycle	2,200
11541 08	8K words core (parity), 1600 nanosec. cycle	2,430
11550 04	4K words core, 980 nanosec. cycle	1,575
11550 08	8K words core, 980 nanosec. cycle	1,700
11560-16	16K words, core, 1200 nanosec. cycle	2,750
12500-00	Power Fail Restart (PFR)	250
12505-01	Interface/mounting for all processor options except PFR	95
12505-02	Teletype interface	100
12505-04	Real Time Clock	225
12505-08	Autoload Bootstrap Loader	175
12505-15	Basic Variables, Teletypewriter Interface, Real-time Clock, and Autoload	545
12505-16	EIA RS 232 interface for CRT console	75
12542-00	Memory Bank Control for memory size beyond 32K words	900
13220-00	16 Channel priority interrupt	500
12034-00	Basic chassis for Naked Mini	275
12907	Expansion chassis for Alpha (5 slots)	500
12044	Power Supply for Naked Mini or 12907	325
12098	Battery pack for semiconductor power failure	150
MASS STORAGE		
18530-43	Moving-Head Disc and control, 2.46 million words	13,200
22530-43	Add-on Drive	11,085
18520-44*	Double Density Disc and Control, 4.96 million words	15,800
22520-44	Add-on Drive	12,885

*No longer in new production.

Computer Automation Naked Mini/Alpha LSI

EQUIPMENT PRICES

		Purchase Price
MASS STORAGE (Continued)		
18520-31*	Disc and control, 1.23 million words	$11,450
22520-31	Add-on Drive	9,300
14520-31	Diablo 31/33 Control Only	2,400
MAGNETIC TAPE EQUIPMENT		
18240-01	Cassette and control, 75 words/sec	2,850
18240-02	Dual cassette and control	4,550
22240-01	Add-on Drive	2,275
22240-02	Dual Add-on Drives	3,975
18224-10*	Drive and control, 18 KBS	7,000
22224-10	Add-on Drive	4,380
18224-20*	Drive and control, 10 KBS	7,600
22224-20	Add-on Drive	4,970
18224-30*	Drive and control, 30 KBS	8,900
22224-30	Add-on Drive	6,300
18224-15	Drive and Control, 30 KBS	7,500
22224-15	Add-on Drive	4,500
14224-00	Control only for customers supplying their own tape transports	2,400
PUNCHED CARD EQUIPMENT		
18223-43	Reader and control, 285 cpm; includes interface, cable, software, and integration**	3,950
14223-43	Control only for customer-furnished reader	600
PAPER TAPE EQUIPMENT		
18223-12	Reader and control, 300 cps	2,430
14223-13	Control only for reader furnished by customer	600
18223-61	Reader/Punch, 300/75 cps	5,790
14223-20/13	Control only for reader/punch furnished by customer	1,200
19223-10	Software for standard reader furnished by customer	250
19223-60	Software for reader/punch combination furnished by customer	250
PRINTER		
18223-31	Printer and control, 165 cps	5,550
14223-30	Control only	600
INTERFACES		
13213-00	16-bit I/O Module	500
13214-00	32-bit Output Module	750
13215-00	32-bit Input Module	750
13216-00	64-bit Output Module	500
13219-00	64-bit Input Module	500
13220-00	16 Channel Priority Interrupt Module	500
13222-00	I/O Driver Module	500
14223-00	Utility I/O Interface	600
COMMUNICATIONS		
14227-1	Asynchronous Control (RS 232C)	650
14227-3	Asynchronous Control (DTL)	625
14236-1	Dual Interface (RT-modem)	575
14236-21	Dual Interface (ASR 33/35)	500
14236-5	Dual Interface (CRT-ASR)	600
14513-00	Synchronous Controller	1,200
14512-21	Asynchronous Multiplexer, 2-line	950
14512-41	Asynchronous Multiplexor, 4-line	1,400
TERMINALS		
22205-00	ASR-33 with paper tape reader/punch, modified	1,650
22230-00	Keyboard Display Terminal, 24 lines by 80 chars., up to 9600 bps	3,175

SOFTWARE PRICES

20025/20026	Documentation/Basic paper tape Program Library (one set for each of first six systems at no charge)	$ 150
19001-00	Advanced Basic, operates in 4K words of memory; 10-yr. license	300
19001-10	Extended Basic, operates in 8K words of memory; 10-yr. license	400
19001-20	Extended Multiuser Basic, 16K words recommended; 10 yr. license	500
19004	XASM Cross Assembler for S/360 or S/370	200
19005	RTX Real Time Executive	500
19007	DOS, or MTDS, or COS Operating Systems	2,000

*No longer in new production.

**Users providing their own peripherals can buy these last three items separately for $150, $300, and $250, respectively.