

Data General Nova 4 Series



The two-board design of Data General's Nova® 4/X computer incorporates CPU, MMPU, async interface, real-time clock, automatic program load, and power fail/auto restart on the CPU board, and up to 256K bytes of memory on a single memory board.

MANAGEMENT SUMMARY

Although new product activity surrounding Data General's Nova 4 line of computers has been minimal in recent months, the Nova 4 system continues to be a viable entry in the traditional 16-bit minicomputer arena by virtue of the large number of systems that are currently on the market. With the recent announcement of Data General's microEclipse line of scientifically oriented processors however, we may be seeing the end of the Nova and microNova computers as actively marketed systems.

Currently, Nova 4 models include the compact Nova 4/C, featuring a complete 64K-byte computer on a single circuit board; the standard Nova 4/S, a higher-performance model with up to 64K bytes of memory implemented on two boards; and the extended-memory Nova 4/X, which features a standard memory management and protection capability allowing a 256K-byte computer to reside on two boards.

All three Nova 4 computers offer significant enhancements over the Nova 3 line in performance, function, ➤

The Nova 4 series of computers consists of the compact, single board Nova 4/C; the higher-performance Nova 4/S; and the extended-memory Nova 4/X computer. There are also five packaged system models based on the Nova 4/C. Prices range from \$3,475 for the Nova 4/C, to \$16,270 for the Nova 4/X.

MAIN MEMORY: 32K to 256K bytes
DISK CAPACITY: 96M to 400M bytes
WORKSTATIONS: Up to 16
PRINTERS: 180 cps to 900 lpm
OTHER I/O: Magnetic tape, paper tape reader/punch equipment.

CHARACTERISTICS

MANUFACTURER: Data General Corporation, Route 9, Westboro, Massachusetts 01581. Telephone (617) 366-8911.

Data General is a leading manufacturer of minicomputers, peripherals, and associated equipment. The company maintains sales offices in most major North American cities and in South America, Europe, and Australia. Manufacturing operations are located in Southboro, Massachusetts; Westbrook, Maine; Portsmouth, New Hampshire; Clayton, North Carolina; and Sunnyvale, California. Assembly operations are also performed in Hong Kong and in Thailand.

MODELS: Nova 4/C, 4/S, and 4/X.

DATE ANNOUNCED: December 1978.

AVAILABILITY: 90 days for all three models.

DATA FORMATS

BASIC UNIT: 16-bit word or 8-bit byte.

FIXED-POINT OPERANDS: 16-bit words can be interpreted as signed or unsigned binary numbers, logical words, memory addresses, or portions of decimal character strings.

Decimal numbers can be either character decimal or packed decimal. In character decimal format, each digit is an 8-bit ASCII character, and the sign is either carried separately as an extra character at the beginning or end of the decimal string or by modifying either the first or last digit in the string. The packed decimal format places each digit in 4-bit hexadecimal code with a separate sign character at one end of the string.

FLOATING-POINT OPERANDS: All Nova processors can implement single- and double-precision floating-point arithmetic through software subroutines. With the optional Floating-Point (FPU) on the 4/S and 4/X, single- and double-precision arithmetic can be handled by the hardware.

INSTRUCTIONS: One-word instructions. There are four basic instruction types; each with a different format: Jump and Modify Memory, Move Data, I/O, and Arithmetic and Logic. The instruction repertoire includes the Nova 3 ➤

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CHARACTERISTICS OF THE DATA GENERAL NOVA 4 FAMILY

	Nova 4/C	Nova 4/S	Nova 4/X
Maximum number of terminals	4	8	16
Standard disk capacity, megabytes	96	200	400
Main memory capacity, bytes:			
Minimum	32K	32K	128K
Maximum	64K	64K	256K

▷ and economy. The Nova 4/C packs the speed of a Nova 3 computer on a single board, and the Nova 4/S and 4/X models feature 50 percent higher speed than the Nova 3. Increased performance also results from instruction set enhancements, which add new byte manipulation and integer arithmetic capabilities to the Nova 3 instruction set.

The Nova 4/X can support dual operations under the RDOS operating system. This capability allows it to run a multi-terminal data entry program in the foreground while processing a remote job entry or local batch program in the background.

The Nova 4/C is a 15-inch single board Nova-series computer with asynchronous interface, auto program load, power fail/auto restart and up to 64K bytes of MOS memory. It features a choice of 16K, 32K, or 64K bytes of MOS memory on a CPU board with 400-nanosecond memory cycle time; multiply/divide and real-time clock options; enhanced microprogrammed architecture with Nova-series instruction set; virtual console with power-up diagnostics and debugging; and a battery backup unit option that supports memory for up to 90 minutes.

The Nova 4/S is a 15-inch single board processor with onboard asynchronous interface, real-time clock, auto program load, and power fail/auto restart. The 4/S features a high-performance Nova-series computer including prefetching processor for instruction look-ahead; enhanced microprogrammed architecture with Nova-series instruction set; four-way interleaved 32K byte and 64K byte MOS memory modules with 400-nanosecond cycle time; virtual console with power-up diagnostics; 16-slot chassis providing maximum configurability or optional 5-slot chassis for small configurations; and multiply/divide (on CPU board), floating-point unit (FPU) and battery backup unit options.

The extended-memory Nova 4/X is a single 15-inch board with onboard asynchronous interface, real-time clock, auto program load and power fail/auto restart. The 4/X features a high-performance Nova-series computer including prefetching processor instruction look-ahead; standard memory management and protection unit, implemented on the CPU board, for utilization of up to 256K bytes of memory; enhanced micro-

▶ instruction set plus local byte, store byte, and signed multiply and divide.

In the Jump and Modify instructions, bits 3 and 4 identify the specific function (op code), and the rest of the word contains information used to calculate the effective address. This information consists of an 8-bit displacement, a 2-bit index register specification, and a 1-bit indicator to specify direct or indirect addressing. In Move Data instructions, bits 3 and 4 address an accumulator, the op code is in bits 1 and 2, and the rest of the word is identical in structure to the Jump and Modify type above. For I/O instructions, bits 5-9 specify the function (indication of transfer direction, selection of an I/O device register, and/or specification of an operation). Bits 3 and 4 select an accumulator for transfer, and bits 10-15 indicate a specific device. Arithmetic and Logic instructions use bits 1 and 2 to identify an accumulator containing a second operand (if present), bits 5-7 to specify primary function, and the rest of the word to specify secondary functions, if any (such as shift and skip test).

For all memory reference instructions, bits 5-15 are used for addressing, using bits 8-15 as the displacement or direct address. Each instruction can address 256 words directly, or can use either relative or base register addressing.

INTERNAL CODE: ASCII and binary.

MAIN STORAGE

TYPE: 4K-chip MOS RAM for 64K-byte memory increments, 16K-chip MOS RAM for 128K- and 256K-byte memory increments; both chips employ N-channel, silicon-gate technology.

CYCLE TIME: 400 nanoseconds, with four-way memory interleaving on the 4/S and 4/X.

CAPACITY: 16,384 to 65,536 bytes for the Nova 4/C; 32,768 to 65,536 bytes for the Nova 4/S; and 131,072 to 262,144 bytes for the Nova 4/X with MMPU (memory management and protection unit).

CHECKING: None.

STORAGE PROTECTION: A memory management and protection unit (MMPU) is available on the Nova 4/X for expanding the memory capacity to 256K bytes, protecting memory, and restricting physical-level I/O device access from user programs. The MMPU divides main memory into 2K-byte pages, and can protect individual pages through software support under the Real-Time Disc Operating System (RDOS).

In addition to the storage protection, the Nova MMPU also provides three other forms of system protection: I/O protection, validity protection, and runaway defer protection. I/O protection prevents the use of any specified I/O device; any instruction attempting to address the protected device causes a system interrupt. Validity protection is used in conjunction with memory mapping and can be extended to any 1024-word page in memory by mapping it to page 127; ▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION
MAGNETIC TAPE	
6125	Streaming magnetic tape subsystem; 1600 bpi, microprocessor controlled, industry compatible
6026	Magnetic tape subsystem includes transport, 9-track, 75 ips, 800/1600 bpi, switch selectable, industry compatible; includes control for up to eight transports
6026-A	Magnetic tape transport; 9-track, 75 ips, 800/1600 bpi, switch selectable, industry compatible
6027	Magnetic tape subsystem includes 9-track transport, 75 ips, 800 bpi, switch selectable, industry compatible; includes control for up to eight transports
6021	Magnetic tape subsystem includes transport, 9-track, 75 ips, 800 bpi, switch selectable, industry compatible; includes control for up to eight transports
6023	Magnetic tape transport 9-track, 75 ips, 800 bpi, switch selectable, industry compatible
TERMINALS	
6106	DASHER D100 display terminal with detached keyboard; includes standard 20mA and EIA interfaces, selectable data rate to 9600 bps, and odd/even/mark or no parity bit; 14 key data entry/cursor control pad mode selectable, 35 programmable function codes, 96 character upper/lower case characters, typewriter style keyboard, and 24 lines x 80 character screen with 7 x 11 dot matrix format
6107	Same as 6106 except includes EIA printer interface for attaching DASHER TP1 or TP2 printer for hard copy of screen contents
6108	DASHER D200 display terminal with detached keyboard; standard 20mA and EIA interfaces, selectable data rate to 9600 bps, and odd/even/mark or no bit parity; 14 key data entry pad and separate cursor control pad, 19 dedicated function keys generate 75 programmable functions, 96 character upper/lower case characters, typewriter style keyboard, and 24 line x 80 character screen with 7 x 11 dot matrix format
6109	Same as 6108 except includes EIA printer interface for attaching DASHER TP1 or TP2 printer for hard copy of screen contents
6052	DASHER D1 alphanumeric video (CRT) display terminal with detachable keyboard; standard EIA or 20mA interface, 11 key data entry pad, 8 function keys, 64 character set (ASCII upper case), teletype-style keyboard, and 24 line x 80 character screen with 5 x 7 dot matrix characters
6053	Same as 6052 except includes 96 character set
6093	DASHER D3 display; CRT with detachable typewriter keyboard, switch-selectable receive and transmit speeds up to 19.2K bps; 20mA or EIA interface standard; 15 key data entry pad, 18 function keys, 96 character set, direct cursor positioning and sensing, programmable intensity plus blink, underscore, reverse video, block fill and field protect
6054	Printer interface option for 6052 or 6053 display
6055	Print station for 6052 or 6053 CRT terminal
6083-A	DASHER D2 display subsystem, 9600 baud, typewriter style keyboard with real-time clock, console interface and cable
6084-A	Same as 6083-A except includes foreground console
6085-A	DASHER D1 display subsystem, 9600 baud teletype style keyboard with real-time clock, console interface and cable
6042	DASHER TP1, 30 cps, keyboard send/receive terminal, 132 column 5 x 7 dot matrix typewriter style keyboard, EIA or 20mA serial interface, 128 character ASCII upper and lower case, buffered carriage return for continuous 30 cps operation
6043	Same as 6042 except receive only without keyboard
6040	DASHER TP1, 60 cps terminal printer, 132 column dot matrix, typewriter style keyboard, EIA serial interface, 128 character ASCII upper and lower case
6041	Same as 6040 except receive only without keyboard
6080-A	DASHER TP1 printer subsystem, 60 cps, with real-time clock, console interface, and cable
6081-A	Same as 6080-A except includes foreground console
6082-A	Same as 6080-A except 30 cps
6110	DASHER APL-ASCII alphanumeric display terminal; APL graphics and ASCII alphanumeric modes are selectable under program control; 1920-character display; detached, movable typewriter keyboard; 7 x 9 dot matrix characters plus 2 scan descenders for lowercase; 20mA and EIA RS-232-C communications interface
6130	DASHER D400 display only (does not include keyboard); standard EIA RS/232 or 20mA communications interface; includes EIA printer interface for attaching TP1 or TP2 printers; up to 24 independent windows
6134	DASHER D450 display only (does not include keyboard); fully compatible with D400 display; memory to store up to 1024 downline loadable, user definable symbols to create special character sets, symbols, graphics and diagrams
6131	Keyboard for DASHER D400 and D450 only
4354	High speed matrix printer; 340 cps, bidirectional, logic-seeking, 96 character set, 7 x 7 half dot matrix; 132 characters per line (cpl) at 10 characters per inch (cpi); standard EIA or 20mA serial interface
6150	DASHER G300 Graphics display only (does not include keyboard Graphics command interpreter); standard EIA RS/232 or 20mA communications interface; alphanumeric capabilities include 640 by 240 pixel resolution; high level English-like graphics commands, and solid area fill capability; all seven character sets are included
6151	Keyboard for DASHER G300 only; sculptured key design with matte key tops
3982	Graphics command interpreter for DASHER G300 (AOS and AOS/VS)
3983	Graphics command interpreter for MP/OS
3984	Graphics command interpreter for RDOS and DOS
6159	Graphics workstation consisting of models 6150, 6151, and 6156
6156	Graphics slave printer
6193	DASHER TP2 receive-only terminal printer; 180 cps, logic-seeking, bidirectional, 7 x 9 impact dot matrix, multilingual capability via seven character sets (96 characters each)
6194	DASHER TP2 keyboard send/receive terminal printer; same as 6193 except includes a typewriter style keyboard with an integral 14-key numeric data entry keypad

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION
PRINTERS	
4353	High Speed Matrix printer, 340 cps, bi-directional logic-seeking, 96 character set, 7 x 7 half dot matrix; 132 cpl at 10 cpi density
4355	High speed matrix printer subsystem; same as model 4353 except includes programmed I/O controller and cables
4356	High speed matrix printer subsystem; same as 4353 except includes data channel controller and cables
4326	230 lpm programmed I/O DG/band printer subsystem; 96 upper/lower case character set
4323	300 lpm DG/band printer; 64 upper case character set; includes DAVFU and forms length selector switch
4324	230 lpm DG/band printer; 96 upper/lower case character set; includes DAVFU and forms length selector switch
4325	300 lpm programmed I/O DG/band printer subsystem; 64 upper case character set; includes DAVFU, forms length selector switch, controller and cables
4327	300 lpm DAta Channel DG/band printer subsystem; 64 upper case character set; includes DAVFU, forms length selector switch, D/CH controller, and cables
4328	Same as 4327 except 230 lpm and 96 upper/lower case character set
4244	900 lpm line printer subsystem; 136 columns, 64 ASCII character set, 6-part form capability, 6 or 8 lines per inch; includes line printer, data channel controller, static eliminator, direct-access vertical format unit, active ribbon control, paper receptacle and cable
4245	Same as 4244 except includes 660 lpm printer and 96 ASCII character set
4215	Same as 4244 except includes 600 lpm printer
4216	Same as 4244 except includes 436 lpm printer and 96 ASCII character set
4217	Optional programmable interval timer
6190	Enhanced DASHER LP2 character printer with parallel interface; 180 cps logic-seeking, bidirectional, 7 x 9 impact dot matrix
6191	Enhanced DASHER LP2 character printer subsystem; same as 6190 but includes programmed I/O controller
6192	Enhanced DASHER LP2 character printer subsystem; same as 6190 but includes a data channel controller
4422-TA	MPT Dot Matrix printer features 150 cps, microprocessor controlled, bidirectional, logic seeking matrix printer, 9 x 9 print format
4363	Printer subsystem for Nova and Eclipse systems; 96 ASCII character set; upper and lower case; includes Data Channel controller
4364	Printer subsystem for Nova and Eclipse systems; 64 ASCII character set; includes Data Channel Controller
4365	Printer only for Nova and Eclipse systems; 96 ASCII character set; upper and lower case
4366	Printer only for Nova and Eclipse systems; 64 ASCII character set
9755	Printer subsystem for the CS small business systems; 96 ASCII character set includes Data Channel controller (upper and lower case)
9756	Printer subsystem for the CS small business systems; 64 ASCII character set; includes Data Channel controller
PAPER TAPE READER/PUNCH	
4007	I/O interface subassembly
4011	Paper tape reader control for 6013 reader
6013	High-speed paper tape reader, 400 cps, fanfold, 8-channel tape, rack mountable
4012	Paper tape punch control for 4012A and 4012B paper tape punch
4013	Remote-operation modification to punch; allows power turn-on, turn-off under program control
4012B	High-speed paper tape punch for use with 4013 remote operations modification

➤ programmed architecture with Nova-series instruction set; four-way interleaved 64K, 128K, and 256K byte MOS memory modules with 400-nanosecond cycle time; virtual console with extensive power-up diagnostics; 16-slot chassis providing maximum configurability or optional 5-slot chassis for small configurations; and hardware multiply/divide (on CPU board), floating-point unit and battery backup options.

Although processor options and configuration rules are not the same among various members of the Nova family, all employ the same basic 16-bit architecture, with four accumulators for computational use (two of which can be used for index registers), an I/O Bus, either a standard or high-speed Direct Memory Access (DMA) data channel, common 15-inch square PC board packaging design, and strong communications capabilities. The actual number of devices that can be configured with any Nova system depends upon the number of available plug-in circuit board "slots" in the chassis.

➤ this indicates that the page is protected and, if addressed by any means, causes a system interrupt. Runaway defer protection prevents infinite indirect loops by counting the number of consecutive times a particular address is referenced through a defer (indirect) cycle; if addressed 17 times consecutively, a system interrupt is generated.

The MMPU holds two program maps and two data channel maps at the same time. Each map consists of 32 1K pages. Although both data channel maps can be enabled at the same time, only one program map may be enabled.

RESERVED STORAGE: Certain low-end memory locations are reserved for use during interrupt servicing, MMPU protection processing, stack fault processing, and power failure. Sixteen locations are reserved for increment and decrement registers.

CENTRAL PROCESSORS

GENERAL: The Nova 4 high-density architecture allows a 64K-byte Nova 4/C to be configured on one board, and a 64K-byte Nova 4/S or 256K Nova 4/X to be configured on two boards. The Nova 4s feature Nova 3 stack capabilities, similar to those of the Eclipse series. The operation of the push-down stack is controlled through two hardware registers, the stack pointer and the frame pointer.

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➤ The Nova series features four operating systems—DOS, RTOS, RDOS/Mapped RDOS, and MP/OS. DOS, the Disc Operating System, is diskette-based, while RTOS, the Real-Time Operating System, is memory-based. Both DOS and RTOS are compatible subsets of RDOS, the Real-Time Disc Operating System, which is hard disk-based. High-level languages are available for the Nova Series: single- and multi-user Extended Basic, Business Basic, Fortran IV (with ISA real-time extensions), and optimizing Fortran 5. An extended assembler, macro assembler, symbolic debugger, communications package, and a library of utilities—sort/merge, plotting routines, commercial subroutines, and text editor—are also available. MP/OS supports the MP/Pascal, MP/Fortran IV, and MP/Basic programming languages.

In the area of data communications, Data General provides RJE80, the Remote Job Entry Control Program; HASP II, the remote batch terminal emulator; SAM, the Sensor Access Manager; and CAM, the Communications Access Manager. RJE80 and HASP II allow for remote job entry and communications between Nova processors and IBM 360/370 systems (in IBM 2780/3780 mode), or between Nova processors and other Data General computers. CAM supports all types of communications and is designed to work with such hardware units as the DCU/50 Data Control Unit and various asynchronous and synchronous multiplexers.

Data General provides its own maintenance and field support service through about 93 field service centers distributed nationwide, which employ more than 500 service personnel. Five depot locations—Framingham, Massachusetts; El Segundo, California; Toronto, Canada; Frankfurt, Germany; and London, England—provide comprehensive repair facilities.

USER REACTION

Thirteen users representing a total of seventeen Nova 4 computers responded to Datapro's 1982 User Survey. The average life of the systems was approximately 20 months, while eleven of the users had purchased their systems, one was rented or leased from the manufacturer, and one was leased from a third party. Moreover, seven of the respondents were first-time computer users. The types of industries responding to the survey included Education, Manufacturing and Retail/Wholesale firms. Principal applications were Accounting/Billing (69 percent), Order Processing/Inventory Control (30 percent), and Payroll/Personnel and Sales Distribution (both 23 percent). The primary sources of application programs came from proprietary software packages (46 percent), in-house personnel (38 percent), and contract programming (30 percent).

The number of local workstations/terminals on-site averaged between four and twelve per user. Remote workstation/terminals, however, averaged between eight ➤

➤ The Nova 4/C is housed in a 5-slot chassis, and the Nova 4/S and 4/X are housed in a 16-slot chassis. The Nova 4's use a horizontally microcoded CPU implementation for overlap, and a look-ahead prefetch processor also increases performance.

Processor options for all Nova 4 models include hardware multiply/divide and a real-time clock. The latter attaches and operates like a peripheral device. An optional hardware floating-point arithmetic unit (FPU) is available for the 4/S and 4/X. The Nova 4 FPU is faster than previous Nova FPU's, executing a double-precision store in 200 nanoseconds and a double-precision add in 1.6 microseconds. An optional battery back-up system can support a single board of memory for 30 minutes on the 4/C and for 90 minutes on the 4/S and 4/X. Recharge time from the fully depleted state is 24 hours during normal CPU operation. One to two milliseconds are provided for the execution of a save routine during a power failure.

CONTROL STORAGE: None.

REGISTERS: All Nova 4 processors have four 16-bit accumulators and a 15-bit program counter. Two accumulators can be used for address indexing. The Nova 4 computers also have a last-in/first-out (LIFO) push-down stack implemented in any 256 consecutive memory locations and two additional hardware registers, the stack pointer and the frame pointer. The stack pointer identifies the first memory location designated as the stack, and the frame pointer marks intra-stack boundaries to permit several "register saves" to be accumulated in the stack.

The MMPU dual program maps are composed of 32 registers, each register controlling a 1K word space. The same is true for the 64 data channel map registers.

Beyond these hardware registers, Nova processors also have 16 reserved memory locations which function as auto-increment or auto-decrement registers when addressed indirectly.

ADDRESSING MODES: Direct addressing of 1024 words via absolute, relative, and indexed modes; multilevel indirect addressing of 32,768 words; stack addressing on a last-in, first-out basis and on a random-indexed basis.

When the MMPU is implemented, the 15-bit logical address coming from the CPU or data channel is translated to a 17-bit physical address. Memory access cycle time is unchanged.

The mapping information needed to service a CPU or data channel request is given to the address translation hardware by the operating system through I/O instructions that reference the address translation hardware. This information is transmitted before the supervisor enables either the user map or the data channel map.

All addresses can be mapped, including those acquired from DMA controllers.

INSTRUCTION REPERTOIRE: All Nova 4's have the same basic complement of 4 Jump and Modify Memory instructions, 2 Move Data instructions, 2 byte manipulation instructions, 7 stack processing instructions, 16 I/O instructions, and 8 arithmetic and logic instructions. (There are 256 variations on each of the arithmetic and logic instructions.) Hardware multiply/divide instructions and a floating-point unit are available as options.

The optional Floating-Point Unit adds 31 I/O-format instructions to the basic set; this option is not available for the Nova 4/C. The 4/X MPPU adds 10 I/O-format instructions. ➤

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workstation/terminals, however, averaged between eight and seventeen (two users had no remote hook-ups). Memory capacities averaged between 142KB to 285KB per user while disk storage totals averaged from 30MB to a high of 95MB. The predominant operating system in use was Data General's RDOS. Ten of the respondents used a data base management system but only two employed integrated work processing functions. Overwhelmingly, the program language used most on these Nova 4's was Basic. When asked if they intended to replace their systems in 1982, eleven users said no. The thirteen users rated their systems as shown in the chart below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	7	1	0	3.3
Reliability of mainframe	6	5	2	0	3.3
Reliability of peripherals	5	4	3	1	3.0
Maintenance service:					
Responsiveness	5	3	5	0	3.0
Effectiveness	3	7	2	0	3.0
Technical support:					
Trouble-shooting	4	4	3	1	2.9
Education	2	3	6	1	2.5
Documentation	2	5	3	3	2.4
Manufacturer's software:					
Operating system	4	6	2	0	3.1
Compilers and assemblers	2	5	2	0	3.0
Applications programs	0	0	0	0	3.0
Ease of programming	4	6	1	1	3.0
Ease of conversion	2	4	2	1	2.7
Overall satisfaction	3	7	2	1	2.9

*Weighted Average on a scale of 4.0 for Excellent.

Concerning the significant advantages of their systems, 46 percent stated they were happy with response times and that the system is easy to expand/reconfigure, and 23 percent said that program/data carried over from other systems are compatible as the vendor promised, and that terminals/peripherals carried over from other systems are compatible as the vendor promised. On the negative side, 15 percent stated that the computer proposed by the vendor was too small, that delivery of required software was late, and that the vendor did not provide all the promised software or support. Only 7 percent stated that installation of equipment was late and that power and/or cooling requirements were excessive. When asked if their system did what it was expected to do, ten users said yes, one said no, and two were undecided. Similarly, when asked if they would recommend the system to another user, nine users said yes, two said no, and two were undecided. □

► **INSTRUCTION TIMINGS:** The following times are the averages of the maximum and minimum values, in micro-seconds, for Nova 4 processors with the standard 400-nanosecond NMOS memory.

Load/Store:	0.8/0.4
Add/Subtract:	0.2/0.2
Multiply/Divide	4.4/5.4
Compare and Branch:	0.2/1.2

INTERRUPTS: Each I/O device is wired to one of 16 bus positions, and can be either authorized or denied authorization to interrupt particular service routines by an Interrupt

Disable Mask Bit that corresponds to the bus position of the device. I/O devices that operate at similar speeds are normally connected to the same mask bit. User-written routines can recognize and process up to 16 levels of priority interrupts.

PROCESSOR MODES: The Nova 4/X recognizes either a supervisor or user mode of program execution for use with the memory allocation and protection options. The executive program runs in the supervisor mode, and can write-protect portions of each user's memory area. With this option and operating in user mode, no user can write in a protected area, use more than 16 levels of indirect addressing, or issue I/O instructions.

The Nova 4/X provides four memory maps: two program maps and two data channel maps, each consisting of 32 2K-byte pages. All addresses can be mapped, including those acquired from DMA controllers.

PHYSICAL SPECIFICATIONS: All Nova 4 processors are housed in either 5.25-inch (5-slot) or 10.5-inch (16-slot) high chassis which are 19 inches wide and approximately 28 inches deep. Weights vary from 40 to 130 pounds fully loaded. The expansion chassis weighs 130 pounds fully loaded. Four AC line voltages are available: 100v, 120v, 220v, or 240v, all operable within the range of 47 to 63 Hz at maximum load. Power consumption is 1200 watts for a fully loaded 16-slot chassis. Recommended operating environment for the Nova 4 computer systems is between 68° F (20° C) and 86° F (30° C), but temperatures between 32° F (0° C) and 130° F (55° C) can be tolerated. Non-condensing humidity of up to 99% can be tolerated.

INPUT/OUTPUT CONTROL

One (4/C) or two (4/S and 4/X) memory buses and a Direct Memory Access (DMA) channel are standard on all Nova 4's. Various high-speed options are available. The DMA data channel provides a multiplexer-like capability and can be seized by any device through a data channel request to handle 16-bit data transfers to and from main memory. In high-speed mode, the maximum word transfer rates per second are: Nova 4/C—625K in, 500K out; Nova 4/S and 4/X—1000K in, 710K out.

CONFIGURATION RULES

The actual number of devices that can be attached to a particular Nova depends upon the available slots in the basic chassis and any available chassis extensions.

All processors occupy one slot. Any size memory module also occupies one slot. The price list at the end of this report states the number of slots remaining after the processor and memory requirements for each particular configuration are satisfied. The multiply/divide feature and parity option share the same board as the CPU. The floating-point option requires one slot.

In general, all peripheral I/O interface subassemblies/controllers require one slot. These include applicable units for reel-to-reel magnetic tape drives, cassette drives, printers, punched card equipment, paper tape units, terminals, plotters, and disc units. Also requiring one slot each are the I/O interface subassembly for the bus control card, various communications controllers, and the DCU/50 and DCU/200 Data Control Units. The programmable interface to an IBM 360/370 requires two slots.

WORKSTATIONS: The maximum number of terminals configurable on the Nova computers are 4 on the 4/C, 8 on the 4/S, and 16 on the 4/X.

DISK STORAGE: See above. ►

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► **MAGNETIC TAPE:** See above.

PRINTERS: See above.

MASS STORAGE

All Data General disc subsystems can be accessed by two controllers to allow dual-processor, shared-disc systems.

6030 FLOPPY DISC SUBSYSTEM: Consists of a four-drive controller and either a 6030 single drive or a 6031 dual drive. Each floppy disc stores up to 315K bytes on 77 tracks. Maximum storage capacity is 1.26 million bytes on a four-drive subsystem. Average head positioning time is 260 milliseconds, and average rotational delay is 83 milliseconds. Data transfer rate is 31K bytes/second. The 6030 drives feature IBM 3740 compatibility and are supported by Data General's RDOS operating system. The controller occupies one slot. The 6030 drives are manufactured by Data General.

6063 AND 6064 FIXED-HEAD DG/DISC SUBSYSTEMS: Consist of a four-drive controller plus up to four 1-megabyte 6063-A disc drives or up to four 2-megabyte 6064-A drives. Each sector contains 512 bytes. There are 32 sectors per track and either 32 tracks per surface (6063) or 64 tracks per surface (6064). Either subsystem can be expanded with 1- or 2-megabyte drives for a total of from 4 to 8 megabytes.

Average rotational delay is 10.22 milliseconds, and the data transfer rate is 910K bytes per second. The pack requires 10 seconds to come up to speed initially and 6 seconds to stop for removal.

6060, 6061, AND 6067 DG/DISC STORAGE SUBSYSTEMS: Consist of a 96-, 190-, or 50-megabyte disc pack drive and a controller for up to four drives. Thus, the same controller can handle from 50 to 760 megabytes of on-line storage. The drives are 3330-type units designed and manufactured by Data General at its Westbrook, Maine, facility. Model 6060 is a 96-megabyte drive, Model 6061 is capable of storing 190 megabytes, and Model 6067 is a 50-megabyte drive. Data density is 4040 bits per inch for all three drives, although their track densities are different. The drives employ a servo track-following technique that allows 192 tracks per inch for a total of 411 tracks per surface on the Model 6060, and 370 tracks per inch for a total of 815 tracks per surface on the Model 6061 and 6067. There is a total of 411 or 815 cylinders, each containing 19 tracks on the 6060 and 6061, or 5 tracks on the 6067.

The Model 6060 employs an IBM 3336-type pack, while the Model 6061 and 6067 utilize an IBM 3336-11-type pack. The 6060 and 6061 disc packs contain 10 platters with 19 usable surfaces, while the 6067 contains 3 platters with 5 usable surfaces. There are 24 sectors per track and 512 bytes per sector, yielding 12,288 bytes per track. Total surface capacity is either 5,050,368 or 10,014,720 bytes per surface, depending on the model. Total formatted drive capacity is 95,956,992 bytes for Model 6060, 190,279,680 bytes for Model 6061, and 50,073,600 bytes for Model 6067.

Disc rotational speed is 3600 rpm, and average rotational delay is 8.3 milliseconds. Track-to-track head positioning time is 6 milliseconds, average head positioning time is 35 milliseconds, and average access time is 43.3 milliseconds.

The controller employed with these drives can handle up to four Model 6060, 6061, or 6067 drives in any combination. Software limitations restrict the number of controllers per system to two. The controller features independent command and read/write channels and reserve-and-trespass capabilities for users to transfer data. In multiple shared-disc environments, privileged file structures are allowed. An error correction feature makes it possible to detect and correct all error bursts of 11 bits or less.

These drives replace the 92-megabyte 4231A and B units that were manufactured by Control Data Corporation and utilized by Data General in the past. Due to formatting differences, the 4231A and B drives may not be intermixed with the 6060 or 6061 drives on the same controller. The new drives can be configured into any Eclipse system supported by the RDOS or AOS operating system. The drives feature a transfer rate of 806K bytes/second.

6045/46/47/48 CARTRIDGE DISC SUBSYSTEMS: Each subsystem consists of a controller and up to four 10-megabyte, top-loading cartridge disc drives. The four systems are being manufactured at Data General's Westbrook, Maine, facility. These subsystems, configured with one, two, three, and four cartridge disc drives, are respectively designated the Model 6045, 6046, 6047, and 6048.

Each drive employs two platters, one fixed and the other an IBM 5540-type removable cartridge, both mounted on a common spindle. Each platter is capable of storing 5,013,504 bytes, or 2,506,762 bytes per surface. There are 200 tracks per inch, 408 tracks per surface, 408 cylinders per drive, and 4 surfaces per drive. Recording density is 2200 bits per inch. All tracks are divided into 12 sectors of 512 bytes each, yielding a formatted track capacity of 6144 bytes. Each cylinder consists of four tracks, giving a formatted cylinder capacity of 24,576 bytes. Total drive capacity is 10,027,008 bytes.

Drive rotational speed is 2400 rpm. Track-to-track, average, and full-stroke head positioning times are 8, 38, and 70 milliseconds, respectively. The data transfer rate is 312,500 bytes per second. Drive start-up to full operating speed takes 30 seconds, and the drive requires 25 seconds to come to a full stop. All four subsystems are supported under the RDOS and RTOS operating systems.

An add-on drive, the Model 6050, allows field upgrading of already installed cartridge disc subsystems. Dual porting can be implemented by adding the Model 6051 option. The Model 6050-F is an add-on drive for an existing floppy disc subsystem. Any mix of floppy and cartridge disc drives up to a maximum of four is allowable. Likewise, floppy drives can be added to a previously installed cartridge disc subsystem. Diskette drives offer advantages in diagnostic program loading and compact file backup.

6070 CARTRIDGE DISC SUBSYSTEM: Consists of essentially the same components and specifications as the 6045 subsystem, except for a doubled recording density resulting in twice the storage capacity and a doubled transfer rate.

6099 DG/DISC STORAGE SUBSYSTEM: Consists of a Winchester-type 12.5-megabyte drive and controller. Two read/write heads access both surfaces of the single disc. Track density is 166 per inch for a total of 348 tracks per surface, and data density is 5760 bpi. The access mechanism is stepper motor driven, controlled by a microprocessor velocity determination algorithm that optimizes head acceleration and deceleration. The 6099 disc controller is located in the Nova 4 CPU. The rotational speed is 2964 rpm, with a data transfer rate of 910K bytes per second. The 6099 allows up to 16 logically contiguous sectors to be transferred with one I/O command. It is fully supported by RDOS.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

Data General is also an OEM peripherals supplier. Its OEM products are covered in Section M13 of *DATAPRO REPORTS ON MINICOMPUTERS*. Data General also provides a broad array of data acquisition, process control, and analog/digital I/O equipment. ►

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► COMMUNICATIONS CONTROL

The DG/CS Communications Subsystem is a hardware and software system that is modular in nature. It is composed of the ALM-16 and ALM-8 Series asynchronous multiplexers, the SLM-2 Series asynchronous multiplexers, the 4251 Communications Chassis, and the DCU/50 or DCU/200 Data Control Unit. The CAM Communications Access Manager provides software support for teletypewriter terminals and Bisync line protocol.

Low-to-medium-performance applications use the appropriate multiplexers in the 4251 chassis, which is connected directly to the host computer I/O bus. For high-performance applications, the DCU/50 is inserted as a "peripheral processor" between the host CPU and the communications subsystem.

The DG/CS supports both full- and half-duplex operation. Line interface support is provided for EIA RS-232C/CCITT V.24, 20-ma current loop, and 23-ma current loop.

The DG/CS is supported by the RDOS, mapped RDOS, and RTOS operating systems. Other software support includes Data General's HASP Work Station Emulator, DCU-resident physical I/O routines, and the aforementioned CAM.

DCU/50 Data Control Unit: Provides a dedicated communications controller consisting of a Nova processor with a local 1K words of memory on a single card that plugs into the host computer chassis. A DMA interface to the host allows any of the host memory to be "windowed" into the DCU/50 address space above 4K to give the DCU access to the host processor's communications buffers without the need to interrupt the host. Communications with the various asynchronous and synchronous line multiplexers is via the DCU/50's I/O bus (separate from that of the host). Control of these multiplexers is in parallel with the main processor. The DCU/50 can be programmed for composite throughputs of up to 48K characters per second over up to 256 asynchronous or synchronous lines. Programming of the DCU/50 can also handle unique protocols and character processing functions. Multiple DCU/50's can be connected to a single Eclipse processor for increased communications loads.

A single DCU/50 can provide 10,000 to 12,000 characters per second of communications throughput with an average of 10 percent computer overhead. The unit is normally used to perform all character-level interrupt processing, control character processing, code translation, error checking, and buffer maintenance.

DCU/200 Data Control Unit: This unit has essentially the same capabilities as the DCU/50, except that it has 4K words of local memory compared to the DCU/50's 1K words, and a 400-nanosecond rather than a 300-nanosecond memory cycle. The DCU/200 acts as an intelligent front end to the processor for communications and sensor I/O applications, off-loading interrupt processing, line protocol, and error-control chores for greater system throughput.

4263/4264 SLM-2 Synchronous Line Multiplexer: Provides one or two lines with speeds of up to 9600 bps as a stand-alone unit or up to 56,000 bps in conjunction with the DCU/50 and an optional high-speed interface for Bell 303 Series modems. Line operation may be either full- or half-duplex. Full character buffering is offered.

Programmable line characteristics include parity type (even, odd, or none); 6-, 7-, or 8-bit code level; SYN (synchronous) and DLE (delete) characters; transmitter/receiver on or off; and either CRC-16 or CCITT-16 cyclic redundancy check

(CRC) polynomials, if the optional CRC Generator/Checker is installed. The internal clock is jumper-selectable to one of eight frequencies from 300 bps to 56,000 bps. Modem control is offered for Bell 201, 203, 208, 209, and 303 or equivalent data sets. Modem control signals include carrier detect, data set ready, ring indicator, request to send, data terminals ready, and clear to send. The RS-232C/CCITT V.24 interface is standard, while an interface for a Bell 303 is optional.

Up to 32 synchronous lines can be supported with the DCU/50 or DCU/200 using 4263 dual-line SLM-2's. Off-line error detection and diagnostics are a standard feature.

4255/4256 ALM-8 Asynchronous Line Multiplexer: Offers a line speed of 5 to 9600 bps on a program-selectable basis. The 4255 offers eight lines, while 4256 offers four. Full-character buffering is standard. Line operation may be full- or half-duplex. Full modem control, including automatic answer capabilities for Bell 103, 202, or equivalent data sets, is standard. Modem control signals include carrier detect, ring indicator, data set ready, request to send, data terminal ready, and clear to send.

Programmable line characteristics include parity type (odd, even, or none); 5-, 6-, 7-, or 8-bit code level; 1 or 2 stop bits; and the aforementioned line speed. Diagnostics and error detection on an off-line basis are standard. Up to 128 asynchronous lines can be supported with the DCU/50 or DCU/200 and the 4255's. The EIA RS-232C/CCITT V.24 interface is standard.

4257/4258 ALM-16 Asynchronous Line Multiplexer: Provides a line speed of 5 to 9600 bps on a program-selectable basis. The 4257 handles 16 lines, while the 4258 handles 8. Full-character buffering is standard. Line operation may be full- or half-duplex. Programmable line characteristics include parity type (odd, even, or none); 5-, 6-, 7-, or 8-bit code level; 1 or 2 stop bits; and the aforementioned line speed. Diagnostics and error detection on an off-line basis are standard. Up to 256 asynchronous lines can be supported with either the DCU/50 or DCU/200 and any combination of the 4257 or 4258. Interfacing is by the 4260 4-line, 20-ma current loop module or the 4261 4-line, EIA RS-232-C/CCITT V.24 module. Both modules can be intermixed on the same ALM-16 board. Interfacing is also available to a Bell 103 data set for manual answer-only operations.

4010 Asynchronous Line Controller: Provides a full-duplex current-loop interface for a local 33 ASR, 33 KSR, 35 ASR, or 35 KSR teletypewriter, a local 6012 video display, or a Bell 103 or equivalent data set through the 4023 EIA interface. The 4029 interface provides control for Bell 103, 202, or equivalent data sets with automatic or manual answer. Clock signals required for the 4023 interface are jumper-selectable. Ten standard frequencies between 75 and 9600 bps are available.

4023 Asynchronous Single-Line Controller: Provides a full-duplex interface for a single Teletype Model 37ASR or 37KSR; 6012 CRT display; or Bell System 103, or equivalent, with manual answer. Standard rate is 150 bps for 10- or 11-unit codes. Other rates are optionally available. The 4029 option adds modem control features for Bell System 202 units with Automatic Answer.

4025 IBM 360/370 Programmable Interface: Attaches to an IBM selector or multiplexer channel, and can simulate the IBM 2803, 2700 series, etc. Operates in multiplexed or burst mode at up to 150,000 bytes per second. A 4025 IBM Software Driver is provided for I/O programming. The 4025 can operate with RDOS or RTOS in a real-time environment. On-line and off-line diagnostics are provided. ►

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► **4061 Asynchronous Multiplexer:** Provides interfaces for up to 64 lines (4 lines per subassembly) at speeds from 45 to 9600 bits per second with 5- to 8-level codes. The 4061 is wired with junction panels to provide system expansion capabilities.

4206 Multiprocessor Communications Adapter: Interconnects up to 15 Nova central processors into multiprocessor rings. The 4206 features simultaneous program-controlled data transmission and reception. Two jumper-selectable modes of operation are available: normal and fast. In normal mode, data is transferred at 625,000 bytes per second. In fast mode, up to 1 million bytes of data are transferred per second. Up to 15 computers are supported in normal mode, while a maximum of four can be sustained in fast mode. The 4206 is fully supported by RTOS and RDOS.

COMMUNICATIONS SOFTWARE

Communications Access Manager (CAM): Supports all types of communications, with or without the DCU/50 or DCU/200 Data Control Unit. SLM-2, ALM-8, and ALM-16 line multiplexers are supported under CAM, as well as the DCU units. CAM is modular and can be generated by the Communications System Generation Program (COMGEN) to include only those program segments required for each individual system. It operates under RTOS, RDOS, or mapped RDOS, and since it uses the operating system's runtime-defined interrupt service, it is brought into main memory from disc only as needed. This frees large segments of memory in a real-time communications system for other processing tasks. Portions of CAM can also reside in the memory of the DCU/50 or DCU/200, if either is present, further reducing main memory overhead.

CAM software can support both standard and special user-defined protocols, including Bisync (BSC) and an asynchronous terminal line procedure. Synchronous and asynchronous protocols can be intermixed. Multi-drop lines are supported through polling and selection sequences. Modem control support for auto answer/auto disconnect is a standard feature. CAM provides a queue for I/O completions that permits a single user task to control several asynchronous lines.

CAM also features a Fortran IV or Fortran 5 interface, permitting communications I/O in Fortran programs.

CAM operates on any Nova processor with 32K bytes of main memory, a real-time clock, and a communications chassis which includes at least one SLM-2, ALM-8, or ALM-16.

Sensor Access Manager (SAM): Data General's Sensor Access Manager provides a library of device handlers and subroutines that control input/output transfers between user programs and analog and digital sensor devices.

Remote Job Entry Control Program (RJE80): Allows for remote job entry and communications between Nova processors and IBM 360/370 systems, or between Nova processors and other Data General computers. Support is provided for four types of RJE systems:

- Point-to-point communications between a Nova or Eclipse emulating an IBM 2780/3780 and an IBM 360/370 host.
- Point-to-point communications between two Data General systems running RJE80.
- Multi-drop Data General systems emulating IBM 3780 slave terminals, communicating with an IBM 360/370 host.
- Multi-drop Data General Systems emulating IBM 3780 slave terminals, communicating with a Nova or Eclipse master system also running RJE80.

RJE80 running under mapped RDOS also allows a user to run one application in either the foreground or background mode while RJE80 runs independently in either mode.

RJE80 is supported by RTOS, RDOS, and mapped RDOS, as well as CAM. Features include horizontal and vertical printer format control; error detection on transmission and reception; and disc, tape, or card transmission to remote systems. Transmission between host systems may be to unattended RJE80 systems, and because of device-independent I/O capabilities, any combination of I/O devices can be utilized without additional software.

Under RTOS, RJE80 requires a 32K-byte Nova with a card reader, line printer, console terminal, real-time clock, 4251 or 4252 communications chassis, and an SLM-2 Synchronous Line Multiplexer.

Under RDOS, RJE80 requires a 48K-byte Nova with 512K bytes of disc storage, a line printer, a console terminal, a real-time clock, a 4251 or 4252 communications chassis, and an SLM-2 Synchronous Line Multiplexer. RJE80 can handle line speeds up to 9600 bps with the SLM-2 or up to 56K bps with the DCU/50 or DCU/200 Data Control Unit and SLM-2 combination. Any modem of the Bell 201, 203, 208, 209, or 303 type, or equivalent, can be utilized.

A library of communications software is available for operation under RDOS, Mapped RDOS, or RTOS. The library includes a Binary Synchronous Communications package callable from Fortran programs, device-independent drivers for intercomputer communications, particular multiprocessor Data General configurations, and direct channel interfacing to an IBM 360 or 370 system.

MP/RJE80 lets MPT Intelligent Workstations, MPT/100, MP/100, MP/200 and Nova 4 computers emulate 2780/3780 remote job entry workstations in three types of communications networks: point-to-point with any Data General computer running RJE software under the MP/OS, DOS, RTOS, RDOS, ICOS, AOS, or 32-bit AOS/VS operating systems; point-to-point with any other computer also emulating 2780/3780; and as multi-drop slave stations dedicated to any master RJE80 emulator.

MP/RJE80 organizes data into blocks up to 512 bytes long, for transmission to a remote host or to another RJE terminal at line speeds to 4800 baud. Through the MP/OS operating system, MP/RJE80 supports dynamic combinations of Data General-compatible I/O devices, including synchronous modems using the RS-232-C interface. It also permits local data transfers from file to file, file to device, or from device to device. MP/RJE80 lets stored command files replace operator-entered commands. This capability simplifies network operation for new users, and facilities unattended operation. Also, MP/RJE80 provides horizontal and vertical printer controls, to increase print throughput without complicated programming. These controls let a printer automatically follow user-defined formats when outputting data fields.

MP/3270 communications utility lets an MP/100, MP/200, Nova 4, or MPT/100-based local communications cluster link with an IBM 360/370/303X computer at speeds up to 4800 baud using standard binary synchronous protocol. MP/3270 software emulates an IBM 3271 cluster controller and an IBM 3277 display. Under the software's control, an MP/100, MP/200 or Nova 4 computer can concurrently support up to four Dasher display terminals on a dedicated multi-drop line. An MPT/100 Technical Desktop Computer can be used either as a display or as a standalone ►

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► synchronous terminal connected with a host computer. In all configurations, MP/3270 also supports one printer connected via a serial interface module.

For optimized execution, both MP/RJE80 and MP/3270 are written in assembly language to run under the MP/OS operating system. MP/OS also supports end-user applications written in the MP/Pascal, MP/Basic, and MP/Fortran IV languages.

HASP II Workstation Emulator lets a Nova system emulate an IBM Hasp remote job entry workstation. The program operates under RTOS, RDOS/Mapped RDOS, or AOS. Its multileaving capability can include up to seven input and seven output data streams. Efficiency of data transmission is achieved by interleaving and data compression. The emulator supports both disk and tape storage.

SOFTWARE

OPERATING SYSTEMS: Five levels of system control programming are available for various configurations of the Nova systems. Each of these includes an appropriate level of language processors and utility programs.

MP/OS is a single-user, multitasking, disk-based, real-time operating system. MP/OS supports MP/Pascal, MP/Fortran IV, and MP/Basic. It provides data management capabilities such as permanent file protection, device-independent I/O access, and hierarchical file directories. MP/OS utilities include a command line interpreter, text editor, macro assembler, binder (compiles object files into relocatable program files), debugger, and library editor.

Real-Time Disc Operating System (RTOS) is a full-scale operating system that supports multi-tasking. It can schedule and allocate program resources to many different sub-program tasks. It is a comprehensive, modular system with a system generation procedure allowing the user to tailor the operating system to his hardware configuration and his application.

RDOS can be used either interactively from a console keyboard or in batch mode from job streams entered via card readers, disc files, cassette files, or magnetic tape files. RDOS can simultaneously support both foreground and background tasks, so that users can run two jobs at the same time. The higher-priority job, which is normally a real-time or response-dependent application program, is run in the foreground, while the lower-priority job is run in the background. Data from a background job is typically processed while waiting for an event or for data from the foreground job. Background mode can also be used to develop new programs without interrupting ongoing jobs. Foreground and background programs can be hardware-protected from each other and from the operating system.

RDOS includes a multi-partitioning system that gives users flexibility in overlaying programs from disc into main memory. Large user programs can be segmented into disc-resident overlays to allow efficient use of main memory and to make the programs more manageable. Tasks stored on the disc occupy main memory only when they are ready for execution. The dual-processor, shared-disc feature allows RDOS users to share peripherals and to access common data and programs on disc.

Also available to RDOS users is the Batch command interpreter and job supervisor. Batch calls in and controls execution of user and system programs. Any program that an on-line user can execute interactively from the console can be called. The Batch processor is not an integral part of RDOS and occupies no main memory when it is not being run.

RDOS supports Business BASIC, Extended BASIC, and Extended FORTRAN IV and 5.

RDOS operates on any Data General minicomputer with 16K words of main memory, a teletypewriter, and a disk. In addition, RDOS can support additional memory (up to 32K words), 8 disk cartridges or disk pack drives, and 8 magnetic tape transports (either 7- or 9-track). Card readers, line printers, communications equipment, and analog and digital conversion equipment are also supported.

Mapped RDOS is available on the Nova 4/X to support two-partition multiprogramming with 32K-word user program areas and an operating system area of up to 32K words (typical size is 8K to 12K words). Mapped RDOS provides an extensive file management capability. It features a common I/O interface, checkpointing for a background task, program segmentation, communication between tasks, and compatibility with RTOS and DOS. Mapped RDOS supports systems of up to 128K words, with each partition protected from the remainder of main memory. Mapped RDOS foreground/background designations are merely a reference to the usual priority designations, which are set up by the user and can be altered at any time. The two partitions could even be given equal priority.

Real-Time Operating System (RTOS) is an upward-compatible subset of the Real-Time Disc Operating System (RDOS). RTOS provides standard interrupt servicing, device handling, and executive scheduling functions. Supporting a multi-tasking environment, RTOS sets up multiple execution paths to perform functions nonsequentially. Tasks are scheduled based on their need to use the processor or I/O devices and the availability of those devices. When more than one task is ready to execute, a multi-level priority structure determines processing sequence by insuring that the highest-priority function is serviced first.

RTOS is modular and re-entrant, and provides the user with a library of modules for system, task, and device processing. It also provides executive functions that schedule task execution. Tasks are scheduled under program or operator control, either after a given time delay, periodically by a real-time clock, or in response to an external event. Once a task begins execution, the task can modify its own priority, can terminate or delay its execution, or can suspend, awaiting the completion of an I/O operation.

In an RTOS-controlled application, asynchronous tasks communicate with each other through an intertask message mechanism. This communication capability makes it possible to coordinate parallel activities controlling the user environment.

RTOS runs on a minimum configuration of 8K words of memory and a real-time clock. It will also support up to 32K words of memory, multiple teletypewriters or CRT's, fixed- and moving-head discs, magnetic and cassette tape transports, paper tape reader/punches, card readers, line printers, plotters, process I/O equipment, and asynchronous, synchronous, and intercomputer controllers.

Real-time support for the Extended and Macro Assemblers and Fortran IV is available under RTOS.

Disc Operating System (DOS) is another upward-compatible subset of the Real-Time Disc Operating System (RDOS). DOS is diskette-based and provides medium-scale program development on a small-scale system. Like its larger brothers, DOS is memory- and file-based. Features provided by DOS include a comprehensive disc and tape file system, device-independent file transparency, multitasking facilities, user program segmentation, and interactive program development via the DOS Command Line Interpreter (CLI). Besides CLI, DOS operates with other Data General system soft- ►

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ware including the text editor, library file editor, and relocatable loader. DOS supports up to 32K words of memory and the full range of peripherals available from Data General.

Languages operational under DOS include the Macro and Extended Assemblers, Basic Interpreter, and Fortran IV Compiler. File management is provided for both random-access and fixed-length sequential files. A multi-task scheduler provides for user-written programs designed to handle multiple terminals, instrumentation and control processes, and complex communications schedulers. Three methods of user program segmentation are employed: chaining, swapping, and overlaying.

DOS requires a Nova with a minimum of 16K words of memory, a real-time clock, a single diskette drive and controller, and a terminal. This configuration can be utilized for user program execution and program development with the Extended Assembler. However, a dual-diskette system is required for DOS generation and for software development using Basic, Fortran IV, or the Macro Assembler.

LANGUAGES: High-level compiler languages available for use on Nova computers include Fortran 5, single- and multi-user Extended Basic, Business Basic, Algol, MP/Pascal, MP/Fortran IV, and MP/Basic.

MP/Fortran IV operates with the MP/OS operating system and implements the ANSI Fortran 1966 Standard. MP/Fortran IV features real-time multitasking capability; comprehensive file structure; full operating system support; free-form, formatted and conversational I/O; compiler-generated reentrant coding; user program swaps, chains and overlays; relational and logical operators; double-precision and mixed-mode arithmetic; and compatibility with DOS, RDOS, and AOS Fortran IV.

MP/Pascal is a high-level structured programming language based on a subset of Nicklaus Wirth's Pascal language. It provides data and programming structures that can clearly represent application data and operations. MP/Pascal features structured data including arrays, strings, records and sets of data, and strong data typing including user-defined types; modular programming extensions; systems-oriented extensions and enhanced I/O; compact threaded code generation; operates under the MP/OS operating system; and offers real-time multitasking capabilities.

MP/Basic is a high-level programming language that conforms to, and is compatible with, the ANSI minimal Basic standard. It incorporates diagnostic, debugging and command functions designed to simplify its use for entry-level operators. Enhancements to the ANSI standard include string variables of unlimited length, string concatenation, substrings, letter-digit array names nine additional mathematic functions, eight string functions, fixed- and variable-length file manipulation, and integer data types. Other features of MP/Basic include interactive program development and execution, random and sequential file access, interfaces with MP/Macro Assembler language, upwardly compatible with AOS/VS Basic, user-controlled tab setting and message printing, and compatibility with MP/OS multi-device peripheral support.

Fortran 5 is a superset of Data General's Fortran IV, ANSI Fortran, IBM Fortran IV (H Extended), and Univac Fortran V. Special compiler features include global code optimization, comprehensive error checking and diagnostics, and re-entrant code. Language extensions beyond ANSI Fortran include static dynamic storage allocation, statement functions expanded as in-line code, data initialization in DIMENSION and data type statements, implied DO loops, flexible declaration order, double-precision and complex arithmetic, IMPLICIT statements, Include statement, full

mixed-mode arithmetic, extended array manipulation capabilities, generic library functions, simplified I/O, bit manipulation, and multi-tasking capability.

Fortran 5 operates on any Data General minicomputer running under RDOS. It requires a minimum of 32K words of main memory, hardware multiply/divide, the floating-point processor, 512K words of disc storage, and a console terminal. Fortran 5 software is supplied on either cassette tape or magnetic tape and requires the appropriate tape drive to interface with the system. Conversational I/O requires a printer terminal or video display console.

Extended Basic has all the features of Time-Sharing Basic as well as extended facilities that allow access to Data General I/O peripherals for both data and program files. Supported peripherals include: high-speed paper tape reader/punch, line printer, fixed-head discs, and moving-head disc pack and disc cartridge drives.

Five versions of the Extended Basic system include:

- Single-user with disc,
- Single-user without disc,
- Multi-user (non-swapping) with disc,
- Multi-user (non-swapping) without disc, and
- Multi-user (swapping) with disc.

The swapping version of Extended Basic will time-slice main memory among multiple users. Extended Basic operates under RDOS or DOS.

Business Basic, developed as a spin-off of the still-viable RDOS Extended Basic, can be run under RDOS or Mapped RDOS. Mapped RDOS users can run Business BASIC as a time-sharing system in one partition while concurrently running a batch, time-sharing, or real-time job in the second partition. Extensions to Basic for business applications in multiple-terminal environments include a multiple-keyed indexed sequential file access method, dynamic record allocation, six-character variable names, common area, direct block I/O, and commercial string functions. Business Basic uses double-precision integer arithmetic, maintaining accuracy to $\pm 21,474,836.47$ and eliminating the rounding problem of floating-point arithmetic. Print formatting statements allow output strings to be left or right justified, filled with a character, or truncated. They also handle decimal points, fixed and floating signs, and zero suppression.

Business Basic provides access to standard RDOS sequential, random, and contiguous files, but also provides its own multiple-keyed indexed sequential file structure for keyed data access. Each ISAM index is a separate, balanced tree-structured file, and multiple indices may have access to the same data file. Data records can be allocated to disc dynamically. Both index and data files have lock and unlock protection. Record lockout provides file integrity when files are accessible by multiple users. An optional interface to the INFOS data management system is available for use with commercial Eclipse systems. Files created with this interface are compatible with INFOS ISAM and DBAM files created by Cobol, Fortran IV, Fortran 5, and the Idea data entry software.

Program development features include the RENUMBER statement for the entire program, the RUNUM statement for specific line numbers, and the VAR statement for a sorted listing of all variables used in a program. A cross-reference listing can also be produced. An attach and detach facility lets a user start a job at a terminal and then detach it to run independently of any terminal, so that the user can work on other programs at the same terminal. For file maintenance, Business Basic statements allow files to be sorted on disc and allow editing of ASCII text files.

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► The file maintenance package also supports simultaneous creation, modification, and accessing of files by multiple users. A set of utility programs is provided to simplify program development and aid documentation. System security is maintained by statements that can prevent users from accidentally accessing Business Basic at the monitor level.

The minimum equipment configuration required for Business Basic is any Nova 4 computer licensed to run RDOS, with 64K bytes of memory, any Data General terminal, a real-time clock, and 10 megabytes of disc storage.

The *Extended Assembler* is similar to the basic Nova Absolute Assembler in that it converts symbolic assembly statements into machine-executable code. In addition to the Absolute Assembler features, the Extended Assembler also provides relocation, interprogram communication, conditional assembly, and more powerful number definition facilities.

The *Macro Assembler* adds extensive macro capabilities to the facilities of the Extended Assembler.

UTILITIES: A library of utility programs for Nova 4 systems includes the Fortran Commercial Subroutine Package, a superset of IBM's CSP for data and format conversion and extended-precision integer arithmetic. Also included are a batch job control supervisor for executing stacked jobs; a real-time I/O system to support A-D and D-A interfaces and RDOS sort/merge; a text editor for 1 to 20 users; a symbolic debugger; Dataplot, a set of Fortran-callable routines for line drawing and axis rotation on digital plotters; and three editing programs—the Macro Editor, the Library File Editor (LFE), and the Octal Editor (OEDIT).

Utilizing simple command string input, the *Macro Editor* edits paper tape input to produce updated paper tape output. The user may define command strings in a special macro register. The command string may then be executed repeatedly by specifying the macro register name in subsequent command strings. A common application for the Macro Editor is the modification of program source tapes in preparation for a new assembly.

LFE allows the user to analyze the contents of a given library file, to merge and update libraries, and to create his own library files.

OEDIT permits the user to examine and modify, in octal, locations on a disc file. A common use of OEDIT is in making simple changes to executable saved files.

The *MP/OS File Management Package*, for microNova MPT/100, and Nova computers, allows the users of small computers such as the MP/100, MP/200, and MPT/100 desktop computers to have the functionality and ease of use of larger computers and operating systems. The File Management Package runs on the MP/OS operating system and has two parts—an Indexed Sequential Access Method (ISAM) and a Sort/Merge utility.

The ISAM allows the user to access information quickly and accurately. It avoids extensive iterative sorting and allows data to be extracted without making multiple passes of a file through a program. The MP/ISAM file structure consists of a data file that contains data records and one or more index files. Each index file contains keys to identify data records, and has pointers that point to the data record in the data file. Though the keys are part of the files' index structure, they are not required to be part of the record. ISAM supports multitasking and interfaces with all MP/OS languages; MP/Pascal, MP/Fortran IV, and MP/Basic.

The Sort/Merge utility provides a range of file sorting and merging options. The utility makes it easy for a user to

merge or include updates in a file that already exists. In sorting, the utility arranges input files sequentially, which helps the user quickly build data bases. The sort utility sorts in ascending or descending order, and merges up to ten sorted files. Either fixed length or variable length records can be used.

APPLICATIONS: No separate applications packages have been announced for the Nova systems. Other software consists of about 20 mathematical routines, more than 24 CPU and peripheral device diagnostics, and a variety of language processor libraries, format conversion routines, etc.

PRICING

POLICY: Data General offers the Nova series on a purchase-only basis, with two types of separately priced maintenance agreements: the On-Call Service contract and the Depot Service contract, which involves return of faulty equipment to a designated repair location. In either case, all parts and labor are included at no additional cost.

Normal prime-time on-call contract service hours are 9 a.m. to 5 p.m. Charges quoted in the price list are applicable to customers within 100 miles of a service center. Additional but uniform monthly charges are in effect beyond 100 miles of a Data General service center. These charges are \$150 for customers between 100 and 300 miles from the center and \$225 for customers beyond 300 miles.

Under a Depot Service contract, any portion of a system may be covered, the minimum contract being \$75. The customer assumes all transportation and insurance costs. For non-contract on-site service, the hourly maintenance rates are \$40 for prime time and \$48 for all other times. A \$135 regular-time or \$165 premium-time minimum charge applies. Depot service hourly labor charges are \$45 for prime time and \$55 for all other times.

Most of the Data General software is unbundled and offered at license fees which are listed in the "Software Prices" section at the end of this report. One-day on-site consulting service, including RDOS system generation, is billable at \$300 plus transportation costs from the nearest office, except for systems costing over \$30,000 with a high-speed input device, where the service is free.

The Data General Software Subscription Service provides automatic updates and documentation for Data General software at a price ranging from \$50 to \$350 per software product, and for \$75 per product on any order totalling \$1,000 or more.

The Hardware Subscription Service provides automatic updates, additions, and notification of new documentation on all Data General hardware for a fixed yearly fee. It is available to any owner of Data General equipment. This includes owners who have purchased their equipment through another vendor. Initial subscriptions include updates for one year. Prices are as follows: Nova processors, \$980; peripherals, \$920; and communications and I/O, \$920. Additional log books for any of the above topics are \$500 each without updates. Yearly renewal rates are \$480 for Nova processors, \$420 for peripherals, and \$420 for communications and I/O. A 40 percent discount applies for additional updates beyond the first to the same type of log book, ordered at the same time and deliverable to the same address.

Data General provides training courses for customers at its Southboro, Massachusetts, headquarters, at its Western Training Center in El Segundo, California, and at its United Kingdom Training Center in Greenford, Middlesex, England. Two training credits are given for each system purchased (end user) or two training credits per purchase agreement ►

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- (OEM). One training credit entitles a customer to approximately one man-week of training. Schedules for training courses can be obtained at any Data General field office.

Courses currently being offered include: Introduction to Small Computers, 3 days, \$175; Introduction to Assembly Language Programming, 10 days, \$625; Assembly Language Program Implementation, 5 days, \$325; Fortran Program Implementation, 5 days, \$325; RTOS, 5 days, \$325; RDOS Assembly, 5 days, \$325; RDOS Fortran, 5 days, \$325; RDOS Systems Programming, 5 days, \$375; Real-Time Fortran for Industrial Control, 3 days, \$225; Small Computer Hardware Fundamentals, 5 days, \$300; Nova Multiply/Divide Option, 2 days, \$150; Floating-Point Unit Option, 3 days, \$225; Basic I/O Interfacing, 2 days, \$150; Magnetic Tape, 3 days, \$275; Data General Cassette, 2 days, \$175; Moving-Head Disc, 3 days, \$275; Line Printer, 2 days, \$175; and Card Reader, 2 days, \$175.

On-site training is available when necessary. Costs involve \$600 per day (with a three-day minimum) for instructional charges including the instructor's daily expenses, instructor's travel expenses, \$100 per weekend for subsistence when incurred, and a per-student charge for actual documentation used.

The Data General Users' Group provides a forum for interchange of programs. The programs are available for a fee to cover reproduction and distribution costs.

Prices shown in the Equipment Prices list are for single-unit quantities. Standard OEM three-to-five quantity discounts of 19 percent apply. Discounts of about 40 percent are available for quantities for 200 or more units. Third-party leases are available.

EQUIPMENT: The following system purchase prices include all required control units, adapters, and cables.

MODEL 8390-H: Consists of a Nova 4/C with 64K bytes of MOS memory, asynchronous interface, automatic program load, power fail/auto restart, and 5-slot chassis. Purchase price is \$4,130.

MODEL 8393-H: Consists of a Nova 4/S with 64K bytes of MOS memory, asynchronous interface, real-time clock, automatic program load, power fail/auto restart, and 16-slot chassis. Purchase price is \$8,825.

MODEL 8395-N: Consists of a Nova 4/X with 256K bytes of MOS memory, MMPU, asynchronous interface, real-time clock, automatic program load, power fail/auto restart, 16-slot chassis, battery backup, and 2-bay cabinet. Purchase price is \$16,270.■

EQUIPMENT PRICES

PROCESSORS

All Nova 4 computers include four accumulators (hardware), I/O system with programmed data transfer, 16-level programmed priority interrupt, extended stack facility, and direct memory access (DMA) data channel, asynchronous interface, power fail/auto restart, auto program load and virtual console. Prices include power supply, and chassis for 19-inch rack. Nova 4 computers have a full memory cycle time of 400 nanoseconds. The CPU board occupies one subassembly slot.

		Purchase Price	Monthly Maint.
8390-G	Nova 4/C computer with 32K bytes MOS memory in 5-slot chassis	\$ 3,475	\$ 50
8391-G	Nova 4/C computer with 32K bytes MOS memory in 16-slot chassis	5,510	63
8390-H	Nova 4/C computer with 64K bytes MOS memory in 5-slot chassis	4,130	57
8391-H	Nova 4/C computer with 64K bytes MOS memory in 16-slot chassis	6,090	68
	Nova 4/S computers have 4-way interleaved MOS memory with a full memory cycle time of 400 nanoseconds. Each memory module mounts on a single printed circuit board		
8392-G	Nova 4/S computer with 32K bytes MOS memory in 5-slot chassis	6,835	63
8393-G	Nova 4/S computer with 32K bytes MOS memory in 16-slot chassis	8,260	75
8392-H	Nova 4/S computer with 64K bytes MOS memory in 5-slot chassis	7,410	72
8393-H	Nova 4/S computer with 64K bytes MOS memory in 16-slot chassis	8,825	85
	Nova 4/X computers, including MMPU, are packaged on a single 15 inch board and occupy one subassembly slot. Each memory module mounts on a single 15 inch printed circuit board and occupies one subassembly slot. Nova 4/X computers have 4-way interleaved MOS memory with a full memory cycle time of 400 nanoseconds		
8394-K	Nova 4/X computer with 128K bytes MOS memory in 5-slot chassis	12,080	88
8395-K	Nova 4/X computer with 128K bytes MOS memory in 16-slot chassis	13,510	106
8394-N	Nova 4/X computer with 256K bytes MOS memory in 5-slot chassis	14,855	114
8395-N	Nova 4/X computer with 256K bytes MOS memory in 16-slot chassis	16,270	133

PACKAGED SYSTEMS

9266 series packaged systems consist of a Nova 4/C 5-slot with 64K bytes of MOS memory, asynchronous interface, real-time clock, power fail/auto restart, console debug with automatic program load, and one of several magnetic storage device options. A cabinet is optional. All systems can be configured in half bay series (1148-A/B) cabinets except 9266-F and G.

9266-A	Nova 4/C 5-slot system with 10MB cartridge disk	16,250	187
9266-B	Nova 4/C 5-slot system with 12.5MB disk and integral 1.26MB diskette	12,660	137
9266-C	Nova 4/C 5-slot system with 25MB disk and integral 1.26MB diskette	15,000	146
9266-D	Nova 4/C 5-slot system with dual 315KB diskettes	8,825	120
9266-E	Nova 4/C 5-slot system with dual 1.26MB diskettes	10,195	149
9266-F	Nova 4/C 5-slot system with 12.5MB disk and DG streaming tape drive (6125)	16,700	154
9266-G	Nova 4/C 5-slot system with 25MB disk and DG streaming tape drive (6125)	19,265	163

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
NOVA 4 OPTIONS			
8381	Real-time clock	440	4
8382	Multiply/divide, including signed and unsigned operations	865	6
8380	Battery backup with power supply	580	3
8383	Multiply/divide and real-time clock	1,265	12
8388	Floating point unit	3,465	27
8397	Internal cable for external I/O bus	275	—
8684-A	Direct connect expansion chassis to be rack mounted directly above the CPU	4,400	32
8684-B	Remote connect expansion chassis	4,500	32
NOVA 4 EXPANSION MEMORY			
8384	32K byte MOS memory module	1,700	22
8385	64K byte MOS memory module	2,400	30
8386	128K byte MOS memory module	3,800	46
8387	256K byte MOS memory module	6,600	56
MULTIPROCESSOR OPTIONS			
8080	I/O Bus switch chassis with 14 I/O slots, power supply, front panel and selector switch connectors for cabling to 2 computers	5,350	65
8081	Bus control card for connecting one computer I/O bus to the 8080 bus switch chassis	2,020	23
8315	I/O bus repeater	1,320	7
4206	Multiprocessor Communications adapter; up to fifteen DGC computers may be interconnected with one 4206 MCA for each computer	2,390	21
4240	Interprocessor bus unit for synchronization and communication between any two DGC computers	2,160	21
1080B	Set of 2 cables to connect one computer with I/O Bus Switch Chassis	360	—
MASS STORAGE			
6067	Disk subsystem includes controller and adapter for up to four drives, a 50MB disk drive, cables, and four disk packs	27,600	200
6067-A	50MB disk drive for adding second, third, and fourth drive	19,900	747
6060	Disk subsystem includes controller and adapter for up to four drives, a 96MB disk drive, cables, and disk pack	32,250	231
6060-A	96MB disk pack for adding second, third, and fourth drive	26,750	168
6061	Disk subsystem includes controller and adapter for up to four drives, 190MB disk drive, cables, and disk pack	35,900	231
6061-A	190MB disk drive for adding second, third, and fourth drive	30,400	168
6062	Dual port option for 6060, 6061, and 6067; include controller plus internal and external cables for dual porting	6,830	55
6045	10MB cartridge disk subsystem including one cartridge disk drive with 5M bytes of removable and 5M bytes of fixed disk storage, controller for four drives, associated cables and one removable disk cartridge	12,475	126
6046	20MB cartridge disk subsystem including two 10M byte cartridge disk drives, controller for four drives, associated cables, and two removable disk cartridges	22,650	210
6047	30MB cartridge disk subsystem including three 10MB cartridge disk drives, controller for four drives, associated cables, and three removable disk cartridges	32,840	294
6048	40MB cartridge disk subsystem including four 10MB cartridge disk drives, controller for four drives, associated cables, and four removable disk cartridges	43,020	378
6051	Dual port option for 6045, 6046, 6047, and 6048; includes controller plus internal and external cables for dual porting	4,950	53
6050	10MB cartridge disk drive for adding a drive in the field to an existing 6045, 6046, or 6047 subsystem	11,180	84
6050-F	10MB cartridge disk drive for adding a drive in the field to an existing diskette subsystem	11,890	121
6070	20MB cartridge disk subsystem including one cartridge disk drive with 10M bytes of removable and 10M bytes of fixed disk storage, controller for four drives, associated cables and six removable disk cartridges	15,400	147
6070-B	Same as 6070 except includes two 40MB cartridge disk drives	24,750	242
6070-C	Same as 6070 except includes 60MB cartridge disk drives	34,100	336
6070-D	Same as 6070 except includes four 80MB cartridge disk drives	43,450	431
6070-A	20MB cartridge disk drive for adding a drive in the field to an existing 6070, 6070-B, or 6070-C subsystem	11,880	95
6063	1M byte head per track disk subsystem including controller for up to four drives, disk drive, and cables	11,350	104
6063-A	1M byte head per track disk drive for adding second, third, and fourth drive	9,150	88
6064	2M byte head per track disk subsystem including controller for up to four drives, disk drive, and cables	15,900	138
6064-A	2M byte head per track disk drive for adding second, third, and fourth drive	13,700	127
6066	4M byte head per track disk subsystem including controller for up to 4 drives, 2 disk drives and all cabling	27,400	264
6065	Dual port option for 6063, 6064, and 6066; includes controller plus internal and external cables for dual porting	5,690	44
6098	12.5M byte non-removable DG/Disk subsystem with 1.26MB diskette drive	8,360	76
6099	12.5M byte non-removable DG/Disk subsystem	6,050	47
6100	25M byte non-removable DG/Disk subsystem with 1.26MB diskette drive	11,220	85
6103	25M byte non-removable DG/Disk subsystem	8,910	56
6099-A	12.5M byte disk drive for expansion for 1.26MB per drive diskette subsystems	5,720	40
6103-A	25M byte disk drive for expansion of 1.26MB per drive diskette subsystem	8,580	49
6030	Dual diskette subsystem including controller for up to four drives, chassis with power supply, two drives, and cable set	4,720	59
6030-A	Dual diskette drive for adding two drives to dual or single diskette subsystems	4,115	53
6030-B	Dual diskette drive for adding two drives to a 10MB cartridge disk subsystem	4,115	53
6031	Single diskette subsystem including controller, chassis with power supply, 1 drive, and cable set	3,500	53
6031-A	Single diskette drive for adding one drive to dual or single diskette subsystems	2,900	46
6031-B	Single diskette drive for adding one drive to a 10MB cartridge disk subsystem	2,900	46
6097-A	Single diskette subsystem including controller that handles diskette and/or 12.5/25MB disk drives	4,620	61
6097-B	Dual diskette subsystem including controller that handles diskette and/or 12.5/25MB disk drives	6,160	88
6096-C	Single diskette drive for adding to 1.26MB per drive diskette subsystem or subsystems containing 12.5 or 25MB disk drive	4,180	39

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MASS STORAGE—(Continued)			
6160	73MB disk subsystem comprising controller, disk drive and all necessary DCH or BMC cables; can add one 6160-A or 6161-A	18,000	90
6160-A	73MB add-on disk for 6160 or 6161 subsystem; includes all cables	14,500	78
6161	147MB disk subsystem comprising controller, disk drive and all necessary DCH or BMC cables; can add one 6160-A or 6161-A	24,000	120
6161-A	147MB add-on disk for 6160 or 6161 subsystem; includes all cables	20,500	108
6070-E	Dual port option for 6070, 6070-B, 6070-C, 6070-D; includes controller plus internal and external cables for dual porting	4,950	53
MAGNETIC TAPE			
6125	Streaming magnetic tape subsystem; 1600 bpi, microprocessor controlled, industry compatible	6,800	46
6026	Magnetic tape subsystem includes transport, 9-track, 75 ips, 800/1600 bpi, switch selectable, industry compatible; includes control for up to eight transports	16,500	121
6026-A	Magnetic tape transport; 9-track, 75 ips, 800/1600 bpi, switch selectable, industry compatible	12,300	89
6027	Magnetic tape subsystem includes 9-track transport, 75 ips, 800 bpi, switch selectable, industry compatible; includes control for up to eight transports	14,100	110
6021	Magnetic tape subsystem includes transport, 9-track, 75 ips, 800 bpi, switch selectable, industry compatible; includes control for up to eight transports	13,800	100
6023	Magnetic tape transport 9-track, 75 ips, 800 bpi, switch selectable, industry compatible	10,300	71
PRINTERS			
4353	High Speed Matrix printer; 340 cps, bi-directional logic-seeking, 96 character set, 7x7 half dot matrix; 132 cpl at 10 cpi density	5,000	60
4355	High speed Matrix printer subsystem; same as Model 4353 except includes programmed I/O controller and cables	5,300	79
4356	High speed Matrix printer subsystem; same as 4353 except includes data channel controller and cables	5,600	90
4326	230 lpm programmed I/O DG/band printer subsystem; 96 upper/lower case character set	9,200	107
4323	300 lpm DG/band printer; 64 upper case character set; includes DAVFU and forms length selector switch	8,700	94
4324	230 lpm DG/band printer; 96 upper/lower case character set; includes DAVFU and forms length selector switch	8,900	94
4325	300 lpm programmed I/O DG/band printer subsystem; 64 upper case character set; includes DAVFU, forms length selector switch, controller and cables	8,900	107
4327	300 lpm Data Channel DG/band printer subsystem; 64 upper case character set; includes DAVFU, forms length selector switch, D/CH controller, and cables	8,900	111
4328	Same as 4327 except 230 lpm and 96 upper/lower case character set	9,200	111
4244	900 lpm line printer subsystem; 136 columns, 64 ASCII character set, 6-part form capability, 6 or 8 lines per inch; includes line printer, data channel controller, static eliminator, direct-access vertical format unit, active ribbon control, paper receptacle and cable	29,400	220
4245	Same as 4244 except includes 660 lpm printer and 96 ASCII character set	31,100	228
4215	Same as 4244 except includes 600 lpm printer	20,750	165
4216	Same as 4244 except includes 436 lpm printer and 96 ASCII character set	22,900	171
4217	Optional programmable interval timer	1,050	8
6190	Enhanced Dasher LP2 character printer with parallel interface; 180 cps logic-seeking, bidirectional, 7x9 impact dot matrix	3,750	42
6191	Enhanced Dasher LP2 character printer subsystem; same as 6190 but includes programmed I/O controller	4,450	56
6192	Enhanced Dasher LP2 character printer subsystem; same as 6190 but includes a data channel controller	5,150	59
4422-TA	MPT Dot Matrix printer features 150 cps, microprocessor controlled, bidirectional, logic seeking matrix printer, 9x9 print format	2,290	45
4363	Printer subsystem for Nova and Eclipse systems; 96 ASCII character set; upper and lower case; includes Data Channel controller	13,300	—
4364	Printer subsystem for Nova and Eclipse systems; 64 ASCII character set; includes Data Channel controller	12,900	—
4365	Printer only for Nova and Eclipse systems; 96 ASCII character set; upper and lower case	12,900	—
4366	Printer only for Nova and Eclipse systems; 64 ASCII character set	12,500	—
9755	Printer subsystem for the CS small business systems; 96 ASCII character set includes Data Channel controller	12,900	—
PAPER TAPE READER/PUNCH			
4007	I/O interface subassembly	250	6
4011	Paper tape reader control for 6013 reader	935	13
6013	High-speed paper tape reader, 400 cps, fanfold, 8-channel tape, rack mountable	1,265	20
4012	Paper tape punch control for 4012A and 4012B paper tape punch	770	13
4013	Remote-operation modification to punch; allows power turn-on, turn-off under program control	330	6
4012B	High-speed paper tape punch for use with 4013 remote operations modification	2,640	28

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
TERMINALS			
6106	DASHER D100 display terminal with detached keyboard; includes standard 20mA and EIA interfaces, selectable data rate to 9600 bps, and odd/even/mark or no parity bit; 14 key data entry/cursor control pad mode selectable, 35 programmable function codes, 96 character upper/lower case characters, typewriter style keyboard, and 24 lines x 80 character screen with 7 x 11 dot matrix format	1,750	19
6107	Same as 6106 except includes EIA printer interface for attaching DASHER TP1 or TP2 printer for hard copy of screen contents	2,150	24
6108	DASHER D200 display terminal with detached keyboard; standard 20mA and EIA interfaces, selectable data rate to 9600 bps, and odd/even/mark or no bit parity; 14 key data entry pad and separate cursor control pad, 19 dedicated function keys generate 75 programmable functions, 96 character upper/lower case characters, typewriter style keyboard, and 24 line x 80 character screen with 7 x 11 dot matrix format	1,950	20
6109	Same as 6108 except includes EIA printer interface for attaching DASHER TP1 or TP2 printer for hard copy of screen contents	2,350	25
6052	DASHER D1 alphanumeric video (CRT) display terminal with detachable keyboard; standard EIA or 20mA interface, 11 key data entry pad, 8 function keys, 64 character set (ASCII upper case), teletype-style keyboard, and 24 line x 80 character screen with 5 x 7 dot matrix characters	2,500	23
6053	Same as 6052 except includes 96 character set	3,000	23
6093	DASHER D3 display; CRT with detachable typewriter keyboard, switch-selectable receive and transmit speeds up to 19.2K bps; 20mA or EIA interface standard; 15 key data entry pad, 18 function keys, 96 character set, direct cursor positioning and sensing, programmable intensity plus blink, underscore, reverse video, block fill and field protect	3,180	25
6054	Printer interface option for 6052 or 6053 display	460	7
6055	Print station for 6052 or 6053 CRT terminal	2,850	35
6083-A	DASHER D2 display subsystem, 9600 baud, typewriter style keyboard with real-time clock, console interface and cable	3,490	33
6084-A	Same as 6083-A except includes foreground console	3,050	28
6085-A	DASHER D1 display subsystem, 9600 baud teletype style keyboard with real-time clock, console interface and cable	3,160	33
6042	DASHER TP1, 30 cps, keyboard send/receive terminal, 132 column 5 x 7 dot matrix typewriter style keyboard, EIA or 20mA serial interface, 128 character ASCII upper and lower case, buffered carriage return for continuous 30 cps operation	2,400	28
6043	Same as 6042 except receive only without keyboard	2,200	25
6040	DASHER TP1, 60 cps terminal printer, 132 column dot matrix, typewriter style keyboard, EIA serial interface, 128 character ASCII upper and lower case	2,650	31
6041	Same as 6040 except receive only without keyboard	2,450	29
6080-A	DASHER TP1 printer subsystem, 60 cps, with real-time clock, console interface, and cable	3,450	41
6081-A	Same as 6080-A except includes foreground console	3,050	36
6082-A	Same as 6080-A except 30 cps	3,200	37
6110	Dasher APL-ASCII alphanumeric display terminal; APL graphics and ASCII alphanumeric modes are selectable under program control; 1920-character display; detached, movable typewriter keyboard; 7x9 dot matrix characters plus 2 scan descenders for lower-case; 20mA and EIA RS-232-C communications interface	2,700	29
6130	Dasher D400 display only (does not include keyboard); standard EIA RS/232 or 20mA communications interface; includes EIA printer interface for attaching TP1 or TP2 printers; up to 24 independent windows	2,000	16
6134	Dasher D450 display only (does not include keyboard); fully compatible with D400 display; memory to store up to 1024 downline loadable, user definable symbols to create special character sets, symbols, graphs and diagrams	2,500	18
6131	Keyboard for Dasher D400 and D450 only	300	4
4354	High speed Matrix printer; 340 cps, bidirectional, logic-seeking, 96 character set, 7x7 half dot Matrix; 132 characters per line (cpl) at 10 characters per inch (cpi); standard EIA or 20mA serial interface	5,150	60
6150	Dasher G300 Graphics display only (does not include keyboard Graphics command interpreter); standard EIA RS/232 or 20mA communications interface; alphanumeric capabilities include 640 by 240 pixel resolution, high level English like graphics commands, and solid area fill capability; all seven character sets are included	3,500	21
6151	Keyboard for Dasher G300 only; sculptured key design with Matte key tops	400	4
3982	Graphics command interpreter for Dasher G300 (AOS and AOS/VS)		
3983	Graphics command interpreter for MP/OS	520	52
3984	Graphics command interpreter for RDOS and DOS	500	50
6159	Graphics workstation consisting of models 6150, 6151, and 6156	5,200	57
6156	Graphics slave printer	1,600	32
6193	Dasher TP2 receive-only terminal printer; 180 cps, logic-seeking, bidirectional, 7x9 impact dot matrix, multilingual capability via seven character sets (96 characters each)	4,050	54
6194	Dasher TP2 keyboard send/receive terminal printer; same as 6193 except includes a typewriter style keyboard with an integral 14-key numeric data entry keypad	4,250	38
COMMUNICATIONS			
4007	I/O interface subassembly	250	6
4008	Real-time clock	460	5
4010	Asynchronous line controller; 20mA current loop interface, full duplex	170	4
4023	EIA (RS232-C) interface for 4010 asynchronous controller	60	3
4029	Modem control for 4023 interface	230	3
4077	Asynchronous line controller; 20mA current loop interface, full duplex	170	2
4078	EIA (RE232-C) interface for 4077 asynchronous controller	60	—
4079	Real-time clock; same as 4008 except uses same I/O interface subassembly as cassette control	460	4
4241	ULM-5 four-line asynchronous multiplexor subsystem for full or half-duplex operation; includes full modem control for Bell 103, 202 or equivalent data sets	1,590	18

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
COMMUNICATIONS (Continued)			
4241-A	Add-on ULM-5 four-line asynchronous multiplexor to expand models 4241 or 4243 to a maximum of 8 asynchronous lines	1,590	18
4243	ULM-5, functional combination of model 4241 four-line asynchronous subsystem plus model 4242 one-line synchronous controller subsystem	3,070	33
4242	ULM-5 one-line synchronous controller; full or half-duplex operation; full modem control for Bell 201, 203, 208, 209 or equivalent data sets and internal clock for direct connection	1,590	18
4074	Synchronous line controller with hardware character assembly, disassembly and full character buffering; programmed I/O	1,710	18
4251	First 4-slot communication chassis; four available slots; includes chassis power supply, terminator card, and I/O cable	2,160	26
4253	Additional 4-slot expansion chassis; includes chassis power supply and four available slots for line multiplexor cards	1,710	18
4254	Data Control Unit (DCU/200) provides a high performance data channel interface to any DGC computer	4,480	44
4232	DG/CS dual access controller subassembly and control panel for implementing dual access to DG/CS communications subsystems	2,990	36
4255	Eight-line programmable asynchronous line multiplexor; full or half-duplex operation; full modem control provided; supports Bell 103, 202 data sets or equivalent	2,520	20
4256	Four-line version of 4255 programmable asynchronous line multiplexor	1,570	20
4257	Sixteen-line programmable asynchronous line multiplexor; for use with local or dedicated lines, full or half-duplex operation	2,520	24
4258	Eight-line version of 4257 programmable asynchronous line multiplexor	1,650	24
4260	Four-line 20mA current loop interface module	210	3
4261	Four-line EIA (RS-232-C/CCITT V24) compatible interface module	210	3
4263	Two-line programmable synchronous multiplexor; full or half-duplex operation, full modem control; supports transparent mode operation	1,810	15
4264	One-line version of 4263 programmable synchronous multiplexor	1,210	15
4265	Optional single-line current loop (23mA) interface for use with Bell 303 data sets or equivalent	240	3
4266	Optional CRC generator and checker	610	6
4340	Eight-line asynchronous modem interface (AMI-8), full duplex operation, full modem control provided; supports Bell 103, 202 data sets or equivalent	2,760	20
4342	Sixteen-line asynchronous terminal interface (ATI-16) for use with local or dedicated lines; full duplex operation	2,900	24
4344	Four-line 20mA current interface module	210	3
4261	Four-line EIA (RS232-C/CCITT V24) compatible interface module; for use with Bell 103 data set or equivalent when manual answer only is used	210	3
4345	Two-line programmable synchronous multiplexor; full duplex operation, full modem control; supports transparent mode operation	2,760	16
4346	One-line version of programmable synchronous multiplexor	1,840	16
4347	Optional single-line current loop (23mA) interface for use with Bell 303 data sets or equivalent	230	3
4075	I/O interface assembly; must be ordered with real-time clock (4079), asynchronous line controller (4077), and/or cassette control (4076)	230	3
4250	Data Control Unit (DCU/50) provides a high performance Data Channel interface to any DGC computer; performs all character-oriented tasks associated with the line multiplexors; supports asynchronous and synchronous (modem or direct-connection) terminal control; occupies 1 slot in DGC CPU; local memory contains 1024 words	3,450	55
4348	BSI-1 bit synchronous interface	1,990	15
4349	BSI-4 bit synchronous interface	4,700	15
4248	BLM-1 bit synchronous line multiplexor	1,990	15
4249	BLM-4 bit synchronous multiplexor	4,700	15

GENERAL PURPOSE INTERFACES

4300	Basic I/O subsystem, includes chassis for up to 16 I/O cards, power supply module, one control card with cable, I/O terminator, and terminal boards for sensor signal connections	2,670	20
4300-A	Additional I/O chassis; same as 4300 except does not include I/O terminator	2,550	20
4301	Chassis control card and cable	1,270	10
4301-A	Additional chassis control card; same as 4301 except does not include I/O terminator	1,070	10
4250	Data Control Unit (DCU/50) provides a high-performance Data Channel interface to any DGC computer	3,450	55
4290	General purpose digital input module for 16 lines	400	4
4291	TTL digital input module; provides input lines plus one external strobe line for user interrupt trigger signals	250	3

SOFTWARE PRICES

		Purchase Price	
		Initial	Subsequent
3100	Real-Time Operating System (Unmapped-RTOS)	\$1,000	\$ 200
3175	RDOS Extended Basic for Nova	2,000	500
3181	Real-Time Disk Operating System (Unmapped RDOS)	4,500	525
3212	RDOS Fortran IV with SFP	1,100	500
3218	RDOS Algol	500	100
3239	RDOS Fortran 5	4,000	2,000
3243	RTOS Magnetic Capabilities	150	50
3247	Dataplot	100	50
3329	RDOS Sort/Merge	400	50
3460	Communications Access Manager Version 1 (CAM 1)	100	50
3481	RDOS Fortran IV with HFP	1,100	500
3510	RDOS Commercial Subroutine Package (CSP)	200	50

Data General Nova 4 Series

SOFTWARE PRICES

		Purchase Price	
		Initial	Subsequent
3556	Real-Time Disk Operating System (Mapped Nova 3 and 4 RDOS)	5,500	575
3574	DOS with Magnetic Tape Support	2,000	450
3597	DOS Extended Basic	2,000	500
3601	RJE80	1,313	1,050
3619	SAM Sensor Access Manager	100	50
3657	DOS Fortran IV with SFP	1,100	500
3709	RDOS Business Basic	4,410	2,625
3720	Real-Time Operating System (Mapped RTOS)	1,200	250
3724	DOS Business Basic	1,680	578
3725	HASP II Workstation Emulator	1,600	1,350
3740	RDOS MBC/1 Monitor Emulator	200	100
3743	DOS-Disk Based Operating System	1,900	400
3770	DOS Fortran IV with HFP	1,100	500
3777	Nova 4 MP/Pascal	2,000	350
3778	Nova 4 MP/Fortran IV	1,100	200
3795	Nova 4 MP/OS Operating System and Utilities	2,000	350
3813	RDOS X.25	1,800	1,300
3830-00F	Nova 4 IC/Cobol—Disk Swapping	8,400	5,000
3830-08F	Nova 4 IC/Cobol—Memory Mapping	8,000	6,000
3831	Nova 4 IC/RJE80 (Interactive Cobol)	3,098	2,100
3832	Nova 4 IC/HASP-II (Interactive Cobol)	3,623	2,625
3321	IBM 360/370 Channel Support (IBMSP)	100	50
3776	MP/OS MP/File Management Package	1,250	400
3779	MP/Basic	1,100	200
3781	MP/OS Bisync Communications	525	315
3953	DTOS for Nova/Eclipse Processors	NC	79
3954	DTOS for Nova/Eclipse Peripherals	NC	79
3983	GCI for MP/OS (Graphics Command Interpreter for Dasher G300)	515	50
3984	GCI for RDOS and DOS	500	50
30049	MP/RJE80	1,500	500
30088	MP/3270	1,500	1,000