

Data General microNova



The microNova family consists of three basic configurations: chip sets, board computers, and fully packaged microNova minicomputers. Recent hardware offerings include graphics terminals, graphics printers, and intelligent terminals.

MANAGEMENT SUMMARY

During 1981, Data General continued to offer new products for the microNova line. New hardware includes a streaming tape drive, a graphics display terminal with a graphics printer, several intelligent workstations with compatible printers, a color alphanumeric display, and a Dasher D 200 terminal with a Katakana keyboard. Latest software offerings are MP/Basic, MP/OS file management, MP/RJE80, and the MP/3270 Communications Utility.

The two compatible series within the current microNova family, the MP/100 and MP/200, like the rest of the microNova family, are designed for OEM applications. Hardware is software- and I/O-compatible with previous microNova products, while offering reduced board sizes, lower power consumption and substantial price/performance improvements.

The MP/100 series product line consists of the board-level computer MBC/1, MBC/2, MBC/3, MP/100 SPU, and MBC/SDX, the box MP/100 in an 8-slot chassis, and packaged systems. The MP/200 series consists of the board-level MP/200 SPU, the box MP/200 in an 8-slot chassis, and the fully packaged MP/200 in a half-bay cabinet with a choice of peripherals. ➤

Data General's microNova is fully compatible with the popular Nova Series minicomputers in architecture and utilizes the complete range of Nova software. In addition, the microNova now supports MP/Basic, MP/OS file management, MP/RJE80 and the MP/3270 communications utility. The microNova 16-bit microprocessor is a 40-pin chip package, and is available by the board or by the box. Board prices start at \$600 and minicomputer prices at \$6,890.

MAIN MEMORY: 8K to 64K bytes.
DISK CAPACITY: 315K to 200 megabytes.
WORKSTATIONS: Application dependent—up to 18.
PRINTERS: 30 to 150 cps, 80 to 300 lpm.
OTHER I/O: Paper tape, magnetic tape, graphics terminals, graphics printers.

CHARACTERISTICS

MANUFACTURER: Data General Corporation, 4400 Computer Drive, Westboro, Massachusetts 01580. 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 at the company's Southboro, Massachusetts headquarters; in Westbrook, Maine; and in Sunnyvale, California. Assembly operations are also performed in Hong Kong and in Thailand.

MODELS: MP/100, MP/200, MBC/1, MBC/2, MBC/3, MBC/SDX.

DATES ANNOUNCED: MP/100 and MP/200, February 1979; MBC/1, May 1978; MBC/2, MBC/3, MBC/SDX, July 1980.

DATES OF FIRST DELIVERIES: MP/100 and MP/200, April 1979; MBC/1, MBC/2, MBC/3, MBC/SDX, November 1980.

NUMBER INSTALLED TO DATE: Not available.

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 ➤

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▷ All the MP/100 variations are built around the mN602 processor with the Nova 16-bit architecture and instruction set, a standard data channel as well as a 2-megabyte/second direct memory access channel, asynchronous memory to allow the use of EPROM as well as PROM memories, support for up to 128K bytes of memory, an integral power monitor, a hardware stack and frame pointer with stack overflow protection, 16-bit hardware multiply and divide, real-time clock, all memory control and timing, integral hidden refresh logic for dynamic RAMs, four general-purpose accumulators (two of which can be used for indexing), programmed priority interrupt to 16 levels, CPU and memory control for DMA, and separate memory and input/output buses.

The I/O Controller (IOC) provides the functions of the 47-line Nova I/O bus by decoding data from a two-line serial I/O bus up to 100 feet in length. The IOC also performs integral device identification, interrupt logic, and per-device interrupt masking.

The board-level MBC/1 combines the mN602 chip with an asynchronous interface, automatic program load, and soft control panel on a 7.5-by 9.5-inch board. The soft control panel allows any ASCII console to supervise program execution, examine and modify memory and CPU registers, and support automatic program loading from any device. RAM boards of the same size are available with 8K, 16K, 32K, and 64K bytes, as are 8K and 16K PROM boards. RAM/EPROM boards with 8K or 32K bytes of RAM, and sockets for 32K bytes of EPROM are also available.

The MBC/2, MBC/3, and MBC/SDX were introduced in July 1980. The MBC/2 and MBC/3 provide an mN602 central processor, three types of memory, and serial and parallel I/O in a single 7.5-by 9.5-inch board. The MBC/2 and MBC/3 differ only in the size of their random access memory capability, with 8K bytes for the MBC/2 and 32K bytes for the MBC/3. Both single-board computers have sockets for up to 1K bytes of programmable read only memory and for up to 32K bytes of erasable programmable read only memory. The boards also have two independent, programmable, asynchronous/synchronous, communication interfaces; 16 lines of digital input; and 16 lines of digital output.

The MBC/SDX board is a debugging aid as well as an I/O expansion interface. It offers all the I/O features of the MBC/2. The SDX board is combined with an MP/100 or MP/200 central processor so that the SDX board acts as an input/output interface for the system.

The MBC/2, MBC/3, and MBC/SDX can be configured in a 4-slot card frame as well as an 8-slot MP/100 or MP/200 chassis. They are compatible with other board products in the DG microNova line.

The MP/100 is designed for instrumentation, remote data acquisition, and process control applications, as was the original microNova line. Its main attraction is the ▷

▷ 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: 32-bit single-precision operands with a 7-bit exponent and signed 24-bit fraction; and 64-bit double-precision operands with a 7-bit exponent and signed 56-bit fraction. Single and double-precision floating-point arithmetic is implemented through software subroutines. No hardware floating-point arithmetic is available.

INSTRUCTIONS: One-word instructions. There are six basic instruction types, each with different formats: Memory Reference (MRI), Arithmetic and Logical (ALC), Input/Output (I/O), Multiply/Divide (M/D), Stack Manipulation (STK), and Central Processor Control (CPU).

In MRI instructions the two-bit operation code is in bits 3 and 4 (no-accumulator operations) or in bits 1 and 2 (accumulator operations), and the effective address is computed from the contents of bits 5 through 15.

Bits 1 and 2 in ALC instructions specify the source accumulator, 3 and 4 the destination accumulator, 5 through 7 contain the operation code, and 8 through 15 contain shift and carry directives.

The multiply or divide op code is contained in bits 8 through 9 of the M/D instruction which, like the I/O, STK, and CPU, contains "011" in bits 1 through 2.

The STK and CPU instructions contain the op code in bits 5 through 9, and the STK instructions also include the accumulator containing stack data in bits 3 and 4.

For all memory reference instructions, bits 5 through 15 are used for addressing, using bits 8 through 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: Dynamic MOS RAM, requiring 64 refresh cycles every 1.8 milliseconds. Refresh is overlapped with CPU execution.

CYCLE TIME: 960 nanoseconds.

ACCESS TIME: 960 nanoseconds.

CAPACITY: 64K words in 4K-, 8K-, 16K-, and 32K-word increments.

CHECKING: None.

STORAGE PROTECTION: None.

RESERVED STORAGE: The microNova has 16 reserved words which function as auto-increment/auto-decrement registers.

CENTRAL PROCESSOR

The microNova processor 16-bit architecture includes frame-oriented stack support and programmable 16-level interrupt capability on a single 40-pin circuit. It executes the full Nova instruction set and includes a real-time clock, power monitor, and transparent refresh for 4K and 16K dynamic RAMs. Its serial I/O bus is functionally equivalent to the ▷

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION	MANUFACTURER
PAPER TAPE EQUIPMENT		
6013	Reader; fanfold tape, 8-channel; 400 cps	Data General
MAGNETIC TAPE UNITS		
6123	Streaming tape drive; 8.5-inch reel, 30 inches per second tape transfer rate	
PRINTERS		
4422	Matrix printer for the MPT only, 150 cps, bidirectional, 9 x 9 dot matrix, 96-ASCII character set, upper and lower case 80-/136-character user-selectable line length, serial RS-232 communications interface	
6156	Graphics; 80 cps, dot-matrix, 72 x 144 dots per inch character resolution, for Dasher G300 graphics display terminal	
TERMINALS		
5100	Intelligent terminal; includes from 8K to 64K bytes of RAM, optional sockets for up to 32K bytes of EPROM, a 12-inch screen (80 columns by 24 lines), seven cursor control functions, line erase, screen erase, character repeat keys, a 96-ASCII character set, upper and lower case, 32 special graphics characters, optional asynchronous and synchronous line interfaces, multiplexers, CRC generation and checking, an 801C auto call interface, and three expansion slots. Supports MP/OS, DOS, and RTOS	
5220	Dasher color display, 1920 characters, 24 lines by 80 characters, 128-ASCII character set, 5 x 9 dot character matrix in a 7 x 10 dot cell, EIA or 20-mA current loop interface, full duplex, up to 9600 bps (async)	
5220K	Keyboard for 5220; typewriter keyboard, 14-key numeric pad, 12-key screen management keypad, 15 program function keys, 5 operator function keys, with a choice of American, British, Danish/Norwegian, French, German, Spanish, or Swedish/Finnish character sets	
6040/6042	Dasher terminal printer; 30, 60 cps	Data General
6052/6053	CRT display; 1920 characters, 64- and 96-character set, switch-selectable speeds from 110 to 19.6K bps	Data General
6012	CRT display; 1920 characters, variable code, local editing, EIA or 20-mA current loop interface, full or half-duplex; up to 4800 bps	Data General
6106/7	Dasher D/100 CRT; 1920 characters, 96-character set, 7 x 11 dot matrix, EIA or 20-mA current loop, 9600 bps (6107 includes printer interface)	Data General
6108/9	Dasher D/200 CRT; 1920 characters, 96-character set, 7 x 11 dot matrix, EIA or 20-mA current loop, 9600 bps (6109 includes printer interface)	Data General
6073	Terminal printer, 7 x 9 dot matrix, 132 positions, 96 character set, 10 or 5 characters per inch, 6 or 8 lines per inch, RAM buffer, 4- to 15-inch forms; receive only; 300 lpm (20-character line) to 80 lpm (132-character line)	Data General
6093	Dasher D3 display terminal; same as 6053 except monitor tilts and swivels	
6150	Dasher G300 graphics terminal with detached keyboard; 1920 characters, 24 lines by 80 characters, 640 x 240 picture element (pixel) matrix, EIA or 20-mA current loop interface, parallel printer port, choice of American, British, French, German, Spanish, or Danish character sets	
6130	Dasher text/graphics display terminal; 256 ASCII character set, multiple windows, line drawing set	
6134	Dasher text/graphics display terminal; same as 6130 except 1,024-character storage capability	
6131	Keyboard for 6130/4; with choice of languages or scientific or word processing symbols	
6180	MPT/80 intelligent terminal; includes 16-bit microNova computer with 60K bytes of memory	
6183	MPT/83 same as MPT/80 except for one added 358K byte minidiskette drive	
6187	MPT/87 same as MPT/80 except for two-integral 358K-byte minidiskette drives	
6188	MPT/100 intelligent terminal includes a 16-bit microNova computer with 64K bytes of memory, 12-inch green phosphor screen, 80-column by 24-line screen, full keyboard with numeric pad, dual minidiskette drives with a total of 716K bytes of storage, two RS-232-C programmable sync/async ports, runs under MP/OS to support Fortran IV, Basic, Pascal, and assembly language	

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- reduction in size from six or seven boards for a typical configuration to only two boards.

The MP/200 is a bipolar implementation of the microNova architecture featuring approximately three times the performance of the MP/100. It is designed for dedicated business and communications applications. Data General states that the MP/200 is rated at roughly the same performance as the earlier Nova 4/C small computer.

The MP/200, like the MP/100, is available on a 7.5-by-9.5-inch board. It executes an add in 840 nanoseconds and a multiply in 4.92 microseconds, 3 and 10 times faster, respectively, than previous microNova products. The MP/200 also provides a faster, 3.7-megabyte/second direct memory access channel and an extended instruction set that includes byte manipulation and multiply/divide operations. An optional basic controller board adds an asynchronous interface with full modem control, power fail/auto restart, automatic program load, programmable real-time clock, and a soft control panel.

Optional communications, sensor I/O, and terminal interfaces are available for both the MP/100 and MP/200. They include floppy and hard disk subsystems, single- and multi-line asynchronous and synchronous controllers; single-card A/D, D/A, and digital I/O interfaces and subsystems; and line printer and peripheral interfaces.

Software support for the microNova includes the firm's Disk Operation System (DOS), the Real-Time Operating System (RTOS), and the MP/OS operating system. Extended Basic, Business Basic, Fortran IV, and DG/L languages are also supported as well as the Command Line Interpreter, Text Editor, Macro Assembler, Library File Editor, and Symbolic Debugger Utilities. Recent software offerings for the microNova are AP/Basic, MP/OS file management, MP/RJE80, and the MP/3270 Communications Utility.

The MP/OS operating system provides development capability on the microNovas, as well as cross development capability with AOS on the Nova 4. MP/OS supports MP/Pascal and MP/Fortran. The languages and MP/OS can be used to develop standalone programs, and applications based in PROM as well as diskette or hard disk.

In 1981, Data General announced the 5100 series of intelligent terminals. A 5100 can be used as a standalone microNova system, a cluster controller, or a remote intelligent subsystem with downline loading and local disk or diskette storage.

A microNova MP/100 backplane is used with the 5100, allowing MP/100 peripherals and interfaces to be part of a system. The 5100 series consists of seven models, is based on the MP/100 microcomputer, and has three expansion slots.

- Nova I/O bus. Data General's mN615 I/O controller integrates all bus interface and protocol logic for each I/O device and generates a 16-bit local data bus.

The basic microNova is a chip set which includes the mN602 microprocessor. Above this level, the microNova is available as a microcomputer on a 7.5- by 9.5-inch printed circuit board. The microNova board computers, MBC/1, MBC/2, MBC/3, and MBC/SDX include the mN602 CPU with hardware multiply/divide, absolute, relative, indexed, deferred, and auto increment/decrement addressing modes; four accumulators, two of which can be used as index words; hardware stack and frame pointers and stack overflow protection; separate memory and I/O buses; and control for DMA transfers.

CONTROL STORAGE: None.

REGISTERS: The microNova has four 16-bit accumulators, and a 15-bit program counter, stack pointer, and frame pointer. Two accumulators can be used for address indexing.

The microNova, like the Nova 3, has a last-in/first-out (LIFO) push-down/pop-up 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 designed as the stack, and the frame pointer marks intra-stack boundaries to permit several "register saves" to be accumulated in the stack. The frame pointer can be set randomly to access words stored in stack frames without popping an entire frame.

Also, like the Nova 3, the microNova has 16 reserved memory locations which function as auto-increment or auto-decrement registers when addressed directly.

ADDRESSING MODES: The microNova has five addressing modes: absolute, relative, indexed, deferred, and auto increment/decrement.

INSTRUCTION REPERTOIRE: The basic complement includes six Memory Reference instructions, eight Arithmetic and Logic instructions, seven I/O instructions, two Multiply/Divide instructions, seven Stack Manipulation instructions, and eight CPU instructions. There are 256 variations on each of the Arithmetic and Logic instructions. Hardware multiply/divide instructions are standard.

INTERRUPTS: A 16-level programmed priority interrupt facility is used to recognize interrupts for I/O operation. Each device is wired to one of 16 bus positions, and is either authorized or denied authorization to interrupt particular service routines by an Interrupt Disable Mask Bit that corresponds to the bus positions of the device.

PHYSICAL SPECIFICATIONS: The microNova, in a minicomputer configuration, is housed in a chassis with 8 slots. The chassis is 5.25 inches high, 19 inches wide, and 14.5 or 23 inches deep; the greater depth is with battery backup.

Power requirements for all chassis types are 100, 120, 220, or 240 VAC ± 10 percent, 47 to 63 Hz. Operating temperatures are 32 to 132 degrees F. A relative humidity of up to 90 percent, noncondensing, can be tolerated. The processor outputs 2512 BTU/hour maximum. Air conditioning requirements are those of a normal office environment.

The chassis weighs approximately 37 pounds without battery backup. Add 5 pounds to the chassis weight for battery backup.

INPUT/OUTPUT CONTROL

INPUT/OUTPUT CHANNELS: An I/O bus and a Direct Memory Access (DMA) channel are standard.

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➤ Data General added the MPT/100 to its MPT line of terminals in July 1981. The MPT/100 has 64K bytes of memory, 716K bytes of dual-diskette storage, and two RS-232-C programmable synchronous/asynchronous ports. In addition, the MPT/100 will interface with microNova peripherals using a microNova I/O bus. A 150 cps MPT/printer is offered for the MPT/100.

When using the MP/OS operating system, the MPT/100 executes the microNova instruction set and supports program development in Fortran IV, Basic, Pascal, and Assembly language.

The MPT/100 is designed for both end users and original equipment manufacturers (OEMs).

USER REACTION

At the time of this writing, no responses have been received from microNova users for the 1982 Datapro Computer Users' Survey; however, six microNova users responded to Datapro's 1981 survey. Each respondent had one system which had been installed for an average of sixteen months. Users represented the engineering/scientific and retail/wholesale community and ran the following applications: payroll/personnel, order processing/inventory control, engineering, purchasing, and sales/distribution.

An average microNova installation included 64K to 128K bytes of memory, 5M to less than 20M bytes of disk storage, 40K to less than 1M bytes of diskette storage, and from one to five local workstations.

The following table summarizes the microNova users' ratings.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	1	4	0	0	3.2
Reliability of mainframe	3	3	0	0	3.5
Reliability of peripherals	1	5	0	0	3.2
Maintenance service:					
Responsiveness	4	1	0	1	3.3
Effectiveness	2	2	2	0	3.0
Technical support:					
Trouble-shooting	1	1	2	2	2.2
Education	0	1	4	1	2.0
Documentation	0	2	2	2	2.0
Manufacturer's software:					
Operating system	1	4	1	0	3.0
Compilers & Assemblers	1	4	1	0	3.0
Applications programs	0	2	0	1	2.3
Ease of programming	1	3	1	0	3.0
Ease of conversion	2	2	0	0	3.5
Overall satisfaction	0	5	0	1	2.7

*Weighted Average on a scale of 4.0 for Excellent.

As the ratings show, a majority of the users were reasonably satisfied with their microNova systems. Specifically, four users were happy with the ease of expanding and reconfiguring the systems; three said that system costs were less than expected, and that programs and data carried over from other systems were ➤

➤ The I/O bus is serial in structure and can be up to 100 feet long. Bipolar transceivers differentially drive the microNova serial I/O signal on a parallel two-line basis. This technique offers high noise immunity and ease of cabling.

The basic I/O bus is etched in the backplane. It functions to provide communication between mainframe-based I/O boards and the CPU board. The basic I/O bus is offered with a standard extension of 15 feet to connect the dual diskette subsystem. Longer extensions as discussed above are optional. Mainframe-based I/O boards are connected to free-standing peripherals by a 50-line device cable.

The Input/Output Controller (IOC), a 40-pin chip located at each device interface, decodes the serial I/O signal and routes it into a parallel 16-line bidirectional data bus for I/O operations. This is the logical equivalent of the 47-line Nova I/O system. The IOC has the ability to address up to 61 I/O devices. The program I/O facility has six commands for each device. Also incorporated are controller start, clear, and I/O pulses and the facility for programmed I/O, program interrupt, and DMA functions.

For the DMA channel, rates are quoted as 148,000 words per second for input and 173,000 words per second for output.

CONFIGURATION RULES

The microNova can have up to 61 peripheral devices attached to the I/O bus. The eight-slot chassis is expandable in eight-slot increments. The actual number of peripherals that can be attached depends upon the available number of slots and the method of attachment.

WORKSTATIONS: The number of workstations that can be attached is dependent on the type of application, but Data General recommends a maximum of 18 workstations.

DISK STORAGE: A maximum of eight diskette/disk controllers can be attached to any microNova.

MAGNETIC TAPE UNITS: See above.

PRINTERS: See above.

MASS STORAGE

6038 FLOPPY DISK SUBSYSTEM: Consists of a four-drive controller and either a 6038 single drive or a 6039 dual drive. Each floppy disk 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 6038 drives feature IBM 3740 compatibility and are supported by Data General's RDOS operating system. The controller occupies one slot. The 6038 drives are manufactured by Data General.

6039 FLOPPY DISK SUBSYSTEM: Consists of essentially the same components and specifications as the 6038 subsystem, except that it is a dual-drive system.

6095-N CARTRIDGE DISK SUBSYSTEMS: Each subsystem consists of a controller and up to four 10-megabyte, top-loading cartridge disk drives. The four systems are being manufactured at Data General's Westbrook, Maine, facility. These subsystems can be configured with one, two, three, and four cartridge disk drives.

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 ➤

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▷ compatible (as the vendor had promised). Two added that terminals and peripherals carried over from other systems were also compatible (as the vendor had promised).

On the opposite side, users mentioned these problems with their systems: two noted that the installation of the equipment was late; two indicated that the delivery of the required software was late; and two stated that the vendor did not provide all the promised software support. Another user told of frustrations with inoperative software and with 6 weeks delay between receipt and installation of a 10M-byte disk.

When asked if they would recommend their systems to other users, four users said "yes", one said "no", and one was undecided.□

▶ 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 DOS and MP/OS operating systems.

6100, 6103, 6098, and 6099 DISK/DISKETTE SUBSYSTEMS: Data General's 6100 disk series consists of integrated disk/diskette Winchester-type subsystems. The four models include a 12.5- or 25-megabyte fixed disk, either with or without a 1.26-megabyte diskette as a file transfer and backup medium. The 6104 and 6105 models include 25-megabyte disk drives while the 6101 and 6102 models include 12.5-megabyte units. Models 6101 and 6104 also contain the 1.26-megabyte diskettes. The units are stepper meter driven and are controlled by a microprocessor.

There are 384 tracks per surface in the 25-megabyte disks, with each of the four surfaces divided into two 192-track bands of 512-byte sectors. A separate read/write head accesses each band. Each eight-track cylinder has 131,072 bytes in 256 sectors.

The 12.5-megabyte disks are formatted the same way except that there are four tracks per cylinder.

The data transfer rate for both units varies with different system configurations.

The diskette has 77 tracks per side formatted into 16 sectors of 512 bytes. Average head positioning time is 100 ms, including settling time. Rotational delay is 83.3 milliseconds at 360 rpm. The data transfer rate is 62.5K bytes per second.

INPUT/OUTPUT UNITS

See the Peripherals/Terminals table.

COMMUNICATIONS CONTROL

The Model 4222 Digital I/O Interface, Model 4223 A/D Interface, and Model 4224 D/A Interface each occupy a

single microNova board. They plug directly into the microNova chassis and provide it with stand-alone data acquisition and control capabilities.

MODEL 4222 DIGITAL I/O INTERFACE: Provides a digital device interface for 16 parallel input and 16 parallel output lines. It also furnishes two strobe output lines and one strobe input line. All lines are TTL-compatible. An internal/external data comparator compares real-time external data against an internal software-programmable condition, allowing the system to detect transient deviations from the condition via polling or interrupts and selectively mask bits for interrupt requests.

MODEL 4223 A/D INTERFACE: Incorporates two 8-channel multiplexers, a differential input instrumentation amplifier, a sample-and-hold unit, and a 12-bit successive approximation converter. Its 16 single-ended or 8 differential inputs are program-configurable. Auto-channel scan (with wraparound capability) and triggering modes are also program-selectable. The A/O subsystem offers jumper-selectable input voltage ranges of 0 to 4, 0 to 10, ± 5 , or $\pm 10V$. According to the vendor, a complete conversion requires only 33 microseconds.

MODEL 4224 D/A INTERFACE: This dual-channel, 12-bit subsystem provides a user-selectable, full-scale output of 0 to 10 or $\pm 5V$, with a settling time of seven microseconds. Each channel's output range is individually set.

DG/DAC INTERFACE BOARD: Interfaces the microNova to sensors, actuators, and associated electrical circuits. Each DG/DAC chassis can accommodate up to 16 chassis control cards with up to 16 lines per card for a total of 256 signal lines per chassis. Any mix of digital and analog cards is allowed in one DG/DAC chassis, which measures 8.75 by 19 by 22 inches, weighs 60 pounds, and comes with power supply, bus terminator, and bus cables.

SENSOR ACCESS MANAGER (SAM): Provides software support for the 4222, 4223, and 4224 data acquisition and control boards, and for the DG/DAC interface. SAM is a library of device handlers and subroutines that control I/O transfers between user programs and analog and digital sensor devices. It is callable by Fortran IV and assembly language programs.

GENERAL-PURPOSE CONTROLLER: Provides a generalized programmed I/O, program interrupt, and DMA interface. An area on the board is pre-drilled and allocated for user-designed and built circuitry. Up to four line interface boards in any combination can be controlled for a maximum of up to 16 asynchronous or 4 synchronous lines.

MODEL 4227 ASYNCHRONOUS LINE MULTIPLEXER: Controls up to four asynchronous communications lines. Each line can be configured for RS-232-C or 20-mA current loop operation and individually programmed for number of bits per character (5 to 8), number of stop bits (1, 1.5, or 2) line speed (up to 19,200 bps), and parity (odd, even, or none). When enabled, parity is automatically checked/generated on each line. The multiplexer supports full- and half-duplex operation. The 4227 provides full character buffering on reception and transmission, program-controlled loopback testing, and modem control with automatic answer capabilities for Bell 103 and 202 Series data sets. Model 4225-S is a pre-requisite for the 4227.

MODEL 4226 SYNCHRONOUS LINE CONTROLLER: Interfaces to medium-speed (9600 bps) synchronous/bisynchronous communications lines, and provides a full- and half-duplex EIA RS-232-C/CCITT V.24 interface and full character buffering on reception and transmission. When coupled with the optional Model 4228 hardware CRC generator, the synchronous line controller can select either of ▶

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► two standard check polynomials, CRC16 or CCITT16. Both idle and sync characters, as well as character size, parity, and loopback testing, are program-selectable. In receive mode, Model 4226 automatically synchronizes data and then strips out the sync character. Standard modem control is supplied for Bell 201, 203, 208, and 209 Series data sets. This synchronous controller also supports IBM Bisynch protocols with full transparency and is program code compatible with the SLM-2 Series synchronous multiplexer used on Data General Nova and Eclipse processors.

Up to four Model 4226 controllers can be configured with a single microNova minicomputer, allowing it to control a maximum of four synchronous lines. Only one CRC generator board is needed per system. Model 4225-S is on pre-requisite for the 4226.

MODEL 4225-S CONTROLLER BOARD: Provides control for up to four line interface boards (4226, 4227) in any combination. Maximum support is 16 asynchronous or 4 synchronous lines. Must be ordered with the 4226 synchronous controller or 4227 asynchronous multiplexer.

MODEL 4336-S SYNC/ASYNCH MULTIPLEXER: Controls up to four synchronous or asynchronous lines, for MP/100, MP/200 or MBC computers.

MODEL 4336-AS ASYNCHRONOUS MULTIPLEXER: Interfaces to up to four asynchronous lines, for the MP/100 or MP/200.

COMMUNICATIONS SOFTWARE

COMMUNICATIONS ACCESS MANAGER (CAM): A modular package that can be generated by the Communications System Generation Program (COMGEN) to include only those program segments required for each individual system. CAM operates under DOS and, since it uses the operating system's runtime-defined interrupt service, is brought into main memory from disk only as needed. This can free large segments of memory in a real-time communications system for other processing tasks.

CAM software can support both standard and special user-defined protocols, including Bisynch (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.

REMOTE JOB ENTRY CONTROL PROGRAM (RJE80): Allows for remote job entry and communications between microNova processors and IBM 360/370 systems, or between microNova processors and other Data General computers. Support is provided for four types of RJE systems:

- Point-to-point communications between a Nova Eclipse, or microNova 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 or microNova master system also running RJE80.

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

MP/RJE80: Allows MP/OS-based MPT intelligent, workstations, MP/100s, MP/200s, and Nova 4 computers to emulate 2780/3780 remote-job-entry workstations in three types of communications networks:

- Point-to-point communications between 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 communications with any other computer also emulating 2780/3780.
- Multi-drop slave stations on dedicated lines to any master RJE80 emulator.

Data is organized into blocks of 512 bytes and transmits to a remote host or to another RJE terminal at line speeds to 4800 baud. A Cyclic Redundancy Check (CRC) character is used to ensure accurate transmission.

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.

MP/3270 COMMUNICATIONS UTILITY: Allows MP/100s, MP/200s, Nova 4s, or any MPT/100-based local communications cluster to link with an IBM 360/370/303X computer. Speeds are 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.

IBM HASP WORKSTATION EMULATOR: Lets a microNova emulate an IBM HASP remote job entry workstation. Its multileaving capability can include up to seven input and seven output data streams. Efficiency of data transmission is achieved through interleaving and data compression.

SOFTWARE

OPERATING SYSTEMS: Two levels are available, the DOS Program Development System, and the larger, real-time MP/OS.

DISK OPERATING SYSTEM (DOS): A subset of RDOS, DOS is designed for use in development systems only. DOS requires a minimum of 16K words and includes a Command Line Interpreter, Text Editor, Library File Editor, and Relocatable Loader. It supports a Fortran IV compiler, and single- and multiple-user Extended Basic and Business Basic interpreters. Since DOS is a compatible subset of RDOS, any program developed under DOS can be run under RDOS or RTOS.

DOS Basic: A subset of RDOS Extended Basic, is upward-compatible with both RDOS and AOS Extended Basic. The interpreter takes advantage of operating system features by supporting device independence, and features extensions to the Dartmouth Basic language. These extensions include ►

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► string arithmetic, matrix operations, user-controlled output formatting, and sequential, random, and contiguous file management. DOS Basic also offers several program development features and an assembly-language interface that allows subroutine calls. Both single- and multi-user versions of DOS Basic have been released by Data General.

DOS Basic implements string variables and literals, string concatenation, a string subsetting. Users can determine the location of a character within a string or the number of characters assigned to a string variable. They can also convert a numeric expression to a string that is its decimal representation, and return the decimal representation of a string variable or literal. In addition, READ and IF/THEN statements may employ strings. Matrix manipulation is achieved through a set of statements such as ADD, SUBTRACT, MULTIPLY, INVERT, and TRANSPOSE. Data General states that matrix dimensioning and redimensioning can easily be accomplished. Complete matrices can be read or written in a single I/O call.

The minimum hardware configuration for single-user DOS Basic is any Nova computer, microNova computer, or microNova computer on a board with 16K words of main memory, a dual diskette drive and controller, and one terminal with appropriate interface. The minimum hardware configuration for multi-user DOS Basic is any microNova with 32K words of main memory, a dual diskette drive and controller, and two terminals with appropriate interfaces. Additionally, a wide variety of peripherals can be supported on a Nova-based DOS Basic system, including diskette drives, magnetic tape drives, line printer, paper tape reader and punch, plotter, and multiple terminals. A maximum of 32K words of main memory can be supported.

MP/OS: is a single-user, multi-tasking, disk-based, real-time operating system. Programs developed on AOS Eclipse systems can be run under MP/OS, within hardware constraints. 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.

The minimum hardware required for MP/OS is 64K bytes of memory, one megabyte of disk or diskette storage, and a console.

An MP/OS File Management package runs with the MP/OS operating system. The two-part package contains an Indexed Sequential Access Method (ISAM) and a Sort/Merge utility. The MP/ISAM File structure consists of a data file containing data records and one or more index files. Each index file contains keys to identify data records and pointers to the data record in the data file. Keys are part of the files' index structure, but are not required to be part of the record. ISAM supports multitasking and interfaces with MP/Pascal and MP/Fortran IV.

The Sort/Merge utility sorts in ascending or descending order, and merges up to ten sorted files. Either fixed length or variable length records may be used. The MP/OS File Management Package is compatible with Data General's Advanced Operating System (AOS).

MP/Basic: is an enhanced version of the ANSI standard which features string variables of any length, string concatenation, substrings, and letter-digit array names. Other enhancements include nine additional math functions, eight string functions, fixed and variable length file manipulation, and integer data types. An assembly language interface is also available.

OTHER SOFTWARE: Data General provides paper-tape software consisting of an editor, assembler, and debugger, designed to operate in 4K words of memory.

PRICING

POLICY: Data General offers the microNova 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 8 a.m. to 6 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.

Under a Depot Service contract, any portion of a system may be covered. The customer assumes all transportation and insurance costs.

Prices shown are for single-unit quantities, OEM quantity discounts apply, and are available from Data General upon request.

Data General software is licensed so as to be included without charge on a system with sufficient Data General hardware to operate it. The software is also available for purchase for use on configurations utilizing other than Data General equipment (e.g., peripherals, add-on memory, etc.).

Data General provides training courses for customers at its Westboro, Massachusetts headquarters, at its Mid-Western center in Arlington Heights, Illinois, and at its Western Training Center in Los Angeles, California, and at six international locations. A special five-day course, "Designing with microNova," covering hardware components design and maintenance, memory systems, instruction set, interfacing, configuration, and program development, is offered. In addition to the centers listed above, this course can be taught at customer locations by special arrangement. Two training credits are given for each development system purchased by an end user, which entitle the customer to approximately one man-week of training. Schedules for training courses can be obtained at any Data General field office.

Software and Hardware Subscription Services are available. They provide automatic updates, additions, and documentation for a fixed yearly fee.

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. ►

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EQUIPMENT PRICES

Purchase price in quantities of:

1-9 10-24 25-49

▶ The MBC/1 single-board computer includes 2K bytes of RAM memory, sockets for 4K bytes of PROM, asynchronous interface, 32-line digital I/O interface. Must be ordered with minimum quantity of five.

8320	MBC/1 single-board computer	\$800	\$705	\$625
8318-A	MBC/1 console debug and diagnostics option supplied on 2 512K-byte PROMs	100	*	*

The MBC/2 and MBC/3 single-board computers include sockets for 1K PROM and 32K EPROM, 2 asynchronous/synchronous interfaces, and 32-line digital I/O interface

8321	MBC/2 with 8K bytes of MOS memory	1,200	1,056	936
8322	MBC/3 with 32K bytes of MOS memory	1,700	1,496	1,326

The MBC/SDX single-board computer includes 2 asynchronous/synchronous interfaces and 32-line digital I/O interface

8323	MBC/SDX	600	528	468
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MP/100 microcomputers include the MP/100 SPU board and memory on two boards. (Minimum quantity of five.)

8521-A	With 8K bytes of RAM memory	850	745	660
8521-B	With 16K bytes of RAM memory	1,000	877	778
8521-C	With 32K bytes of RAM memory	1,400	1,235	1,095
8521-D	With 64K bytes of RAM memory	1,950	1,709	1,515
8521-E	With 8K bytes of RAM memory and 32K bytes of EPROM (sockets)	1,100	968	858
8521-F	Same as 8521-E except 32K bytes of RAM memory	1,600	1,412	1,252

MP/200 microcomputers include the MP/200 SPU board and memory on two boards, do not include controller board (8676).

8671-B	With 16K bytes of RAM memory	1,860	1,575	1,445
8671-C	With 32K bytes of RAM memory	2,245	1,980	1,750
8671-D	With 64K bytes of RAM memory	2,905	2,565	2,270

PROCESSOR OPTIONS

8521-G	MP/100 SPU board	800	702	622
8676	MP/200 controller board with asynchronous interface, virtual console with automatic program load, programmable real-time clock, and power fail/auto restart	725	640	565
4310	8-slot chassis with mounting box, fans, and power supply; does not include front panel	1,210	1,065	945
4311	Front panel for 4310	120	110	94
4312	4-slot card cage with back panel and lugs for power supply	210	195	170
4313	Power supply board	665	590	525

Purchase Price On-Call Service

4207-S	Asynchronous interface board for asynchronous terminals	285	6
4208	Console debug option, includes automatic program load routine	255	NC
1112D	I/O bus cable	110	*
4210-S	General-purpose interface card accommodates I/O controller circuitry, logic for programmed I/O, program interrupt, and DMA interface	275	*
4211	Interface Card Wire Wrap Pins and Sockets	220	*
2303A	Circuit Card Extender	220	*

MEMORY

8522	8K-byte MOS RAM board (MP/100 or MBC only)	420	8
8523/8673	16K-byte MOS RAM board (MP/100 or MBC only / MP/200 only)	575	13
8524/8674	32K-byte MOS RAM board (MP/100 or MBC only / MP/200 only)	1,050	17
8525/8675	64K-byte MOS RAM board (MP/100 or MBC only / MP/200 only)	1,940	21
8317	PROM socket board for up to 16K bytes of PROM (MP/100 or MBC only)	290	*
8680	8K bytes of RAM, sockets for up to 32K bytes of EPROM (MP/100 only)	630	*
8681	Same as 8680 except 32K bytes of RAM (MP/100 only)	1,260	*

*Prices not available.

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>On-Call Service</u>
MASS STORAGE			
6100	Fixed-disk subsystem; 25-megabyte drive with 1.26 megabyte diskette drive	11,200	85
6103	Same as 6100 without diskette	8,910	56
6038	Single-drive 315K-byte diskette subsystem with controller	3,510	44
6039	Same as 6038 except dual drive	4,720	53
6095-N	DG/Cartridge disk drive, F/R 10 megabytes with controller and one removable cartridge disk	11,535	82
6101/6098	DG/Disk Storage Subsystem; includes 12.5-megabyte non-removable disk pack drive, 1.26 megabyte diskette drive, cables, and dress panels	8,030/8,360	74/76
6102/6099	Same as 6101 without diskette	5,720/6,050	45/47
6104	Same as 6101 except 25-megabyte disk pack	11,200	83
6105	Same as 6101 except 25-megabyte disk pack without diskette	8,910	54
MAGNETIC TAPE EQUIPMENT			
6123	Streaming tape drive, 8.5-inch reel, 30 ips off-line tape transfer rate, 1600 bpi	6,600	46
PRINTERS			
6156	Graphics slave printer for Dasher G300 graphics display terminal only	1,600	32
4422-TA	Matrix printer for the MPT only; 150 cps, bi-directional	2,290	45
PAPER TAPE EQUIPMENT			
4220-AS	Paper tape reader control for 6013 reader	400	8
6013	High speed paper tape reader, 400 cps, fanfold, 8-channel tape	1,265	20
TERMINALS			
5100MA	Intelligent terminal, MP/100 CPU, 8K bytes RAM	5,100	57
5100MB	Intelligent terminal, MP/100 CPU, 16K bytes RAM	5,400	81
5100MC	Intelligent terminal, MP/100 CPU, 32K bytes RAM	5,800	85
5100MD	Intelligent terminal, MP/100 CPU, 64K bytes RAM	6,300	88
5100ME	Intelligent terminal, MP/100 CPU, 8K bytes RAM, 32K bytes EPROM sockets	5,400	62
5100MF	Intelligent terminal, MP/100 CPU, 32K bytes RAM, 32K bytes EPROM sockets	6,000	66
5100MG	Intelligent terminal, MP/100 CPU, 64K bytes RAM, 32K bytes EPROM sockets	7,600	88
5220	Dasher D280C color display terminal 24 x 80 characters, 5 x 9 dot character matrix in a 7 x 10 cell, 128-character set, speeds to 9600 bps	3,500	*
5220K	Keyboard for 5220	250	*
6042	Dasher terminal printer, 30 cps, KSR	2,400	28
6043	Dasher terminal printer, 30 cps, RO	2,200	25
6040	Dasher terminal printer, 60 cps, KSR	2,650	31
6041	Dasher terminal printer, 60 cps, RO	2,450	29
6052	Dasher D1 display terminal; 24 lines by 80 characters, 5 x 7 dot matrix, 64-character set, speed to 19.2K bps, with detachable teletype-style keyboard	2,500	23
6053	Dasher D2 display terminal; 24 lines by 80 characters, 5 x 8 dot matrix, 96-character set, additional features such as blink and underscore, speed to 19.2K bps, with detachable typewriter-style keyboard	3,000	23
6093	Dasher D3 display terminal; same as 6053 except monitor tilts and swivels	3,180	25
6106	Dasher D100 CRT; 24 lines by 80 characters, 7 x 11 dot matrix, 96-character set, speed to 9600 bps, with detachable typewrite-style keyboard, 35 programmable function codes	1,750	19
6107	Same as 6106 plus printer interface, split baud option	2,150	24
6108	Dasher D200 CRT; 24 lines by 80 characters, 7 x 11 dot matrix, 96-character set, speed to 9600 bps, with detached typewriter-style keyboard, 75 programmable function codes	1,950	20
6109	Same as 6108 plus printer interface, split baud option	2,350	25
-----	Same as 6108, except Katakana character set	2,350	*
6150	Dasher G300 graphics terminal; 24 x 80 characters, 640 x 240 picture element (pixel) matrix, seven character sets, to 9600 bps, includes parallel printer port and detached sculptured keyboard	3,500	21
6151	Keyboard for Dasher G300 only	400	4
6130	Dasher D400 text/graphics terminal; 256-character set	2,000	16
6134	Dasher D450; same as 6130 except 1,024-character storage capability	2,500	18
6131	Detachable sculptured keyboard for 6130/4	300	4
6180	MPT/80 intelligent terminal	4,100	33
6183	MPT/83 intelligent terminal with 1 integral 358K-byte minidiskette drive	4,600	56
6187	MPT/87 intelligent terminal with 2 integral 358K-byte minidiskette drives	5,250	63
6188	MPT/100 intelligent terminal with 64K bytes memory, dual minidiskette drives totalling 716K bytes of storage, 2 RS-232-C programmable sync/async ports	5,350	63

*Prices not available.

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>On-Call Service</u>
▶ GRAPHICS WORKSTATION			
	Graphics workstation; includes G300 graphics terminal, keyboard, and printer	5,200	*
COMMUNICATIONS			
4220-BS	Programmable Real-Time Clock	385	6
4225-S	Controller board for 4226 and 4227 controllers	385	4
4226-S	Programmable synchronous controller; maximum of 4 per 4225	440	6
4227-S	Programmable 4-line asynchronous controller; maximum of 4 per 4225	550	8
4300	DAC chassis; includes 16 I/O card slots with control card to support data acquisition and control sensor I/O subsystem modules	2,670	20
4228-S	CRC Generator	275	4
4222-S	Digital I/O interface; provides 16 input lines with strobe	490	7
4223	A/D Converter	1,400	14
4224	Analog voltage output module; includes 2 D/A converters	970	12
4336-AS	Asynchronous multiplexer, 4 lines	660	8
4336-S	Asynchronous/synchronous multiplexer, 4 lines	825	9
CABINETS AND HARDWARE			
1144-A	Bay with 19" rack cabinet; 60 x 30 x 25 inches	1,820	*
1148-A	Half bay	550	*
		<u>Initial License Fee</u>	<u>Subsequent License</u>
SOFTWARE			
3776	MP/OS File Management	1,250	400
COMMUNICATIONS SOFTWARE			
MP/RJE80		1,500	*
MP/3270		1,500	*

*Prices not available.■