NEC

NEAC-SERIES 2200 GENERAL

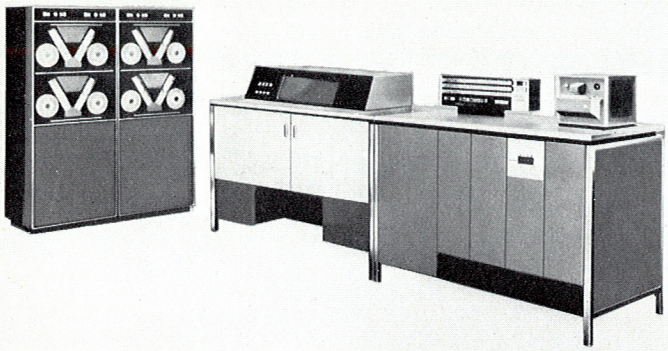
NEAC-SERIES 2200 / 50 / 100 / 150 / 200 / 250 / 300 / 400 / 500 / 700

Dimensional Data Processing

Nippon Electric Company, Limited

NEAC-SERIES 2200

Model 50



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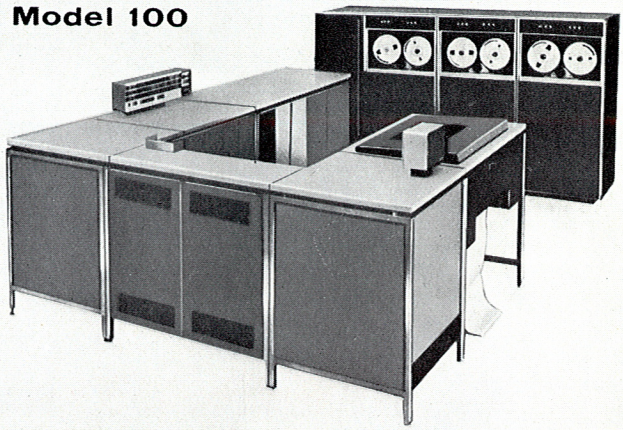

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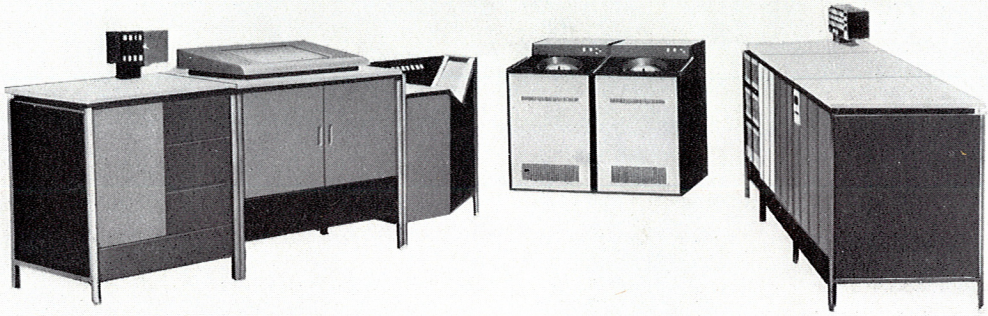

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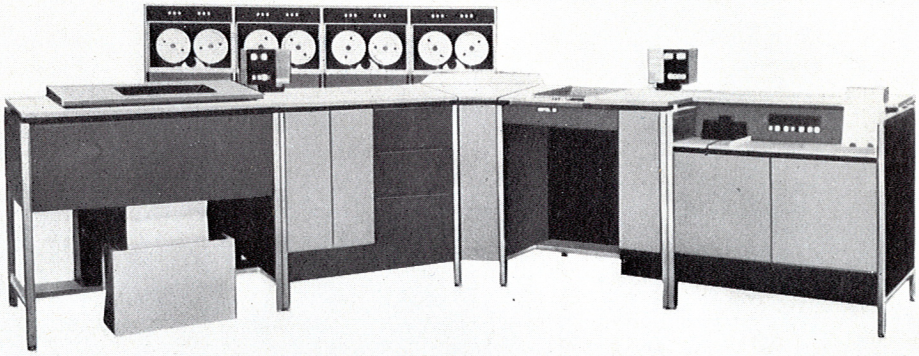

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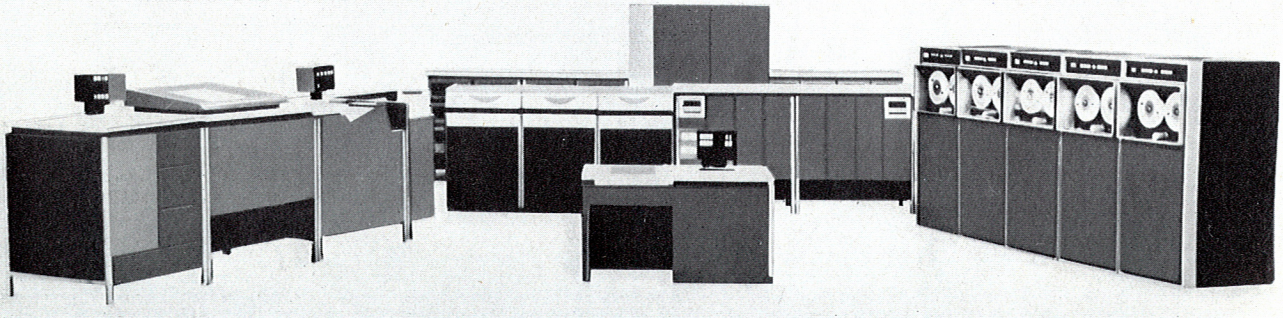

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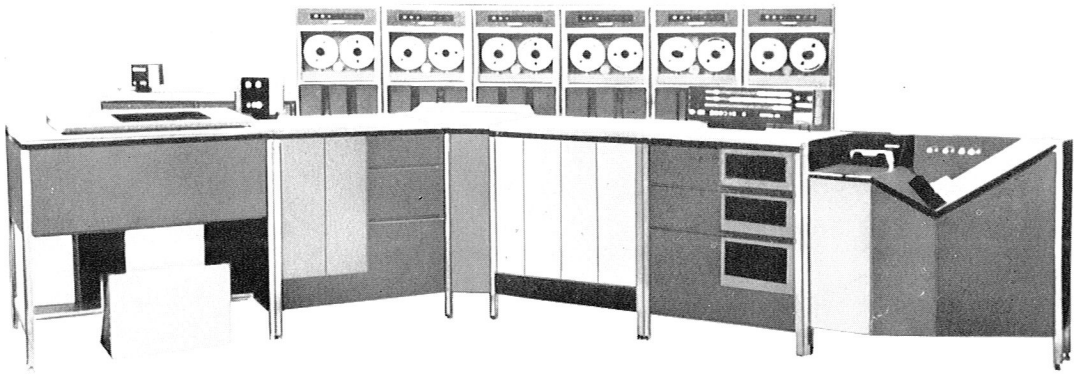

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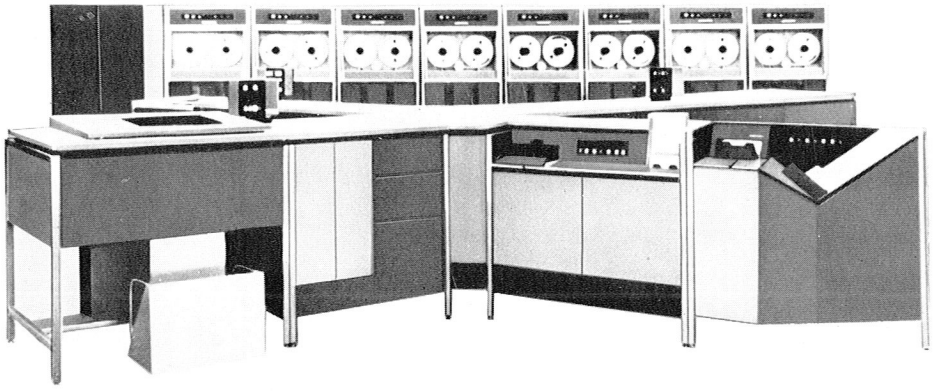

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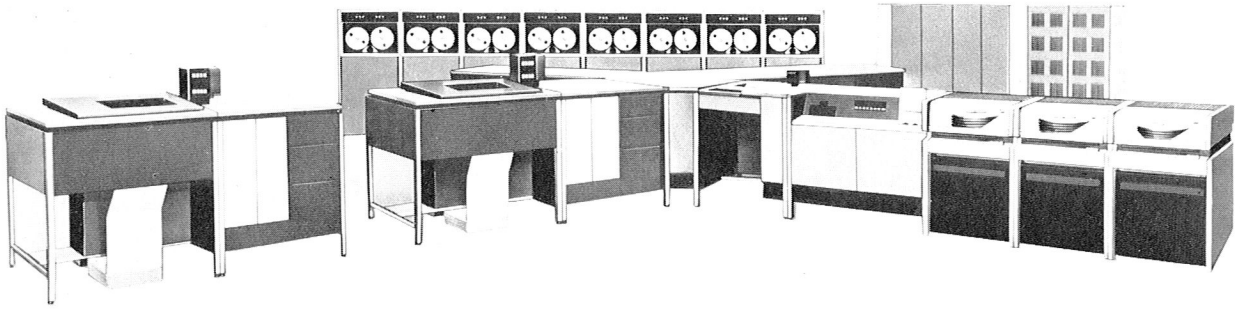

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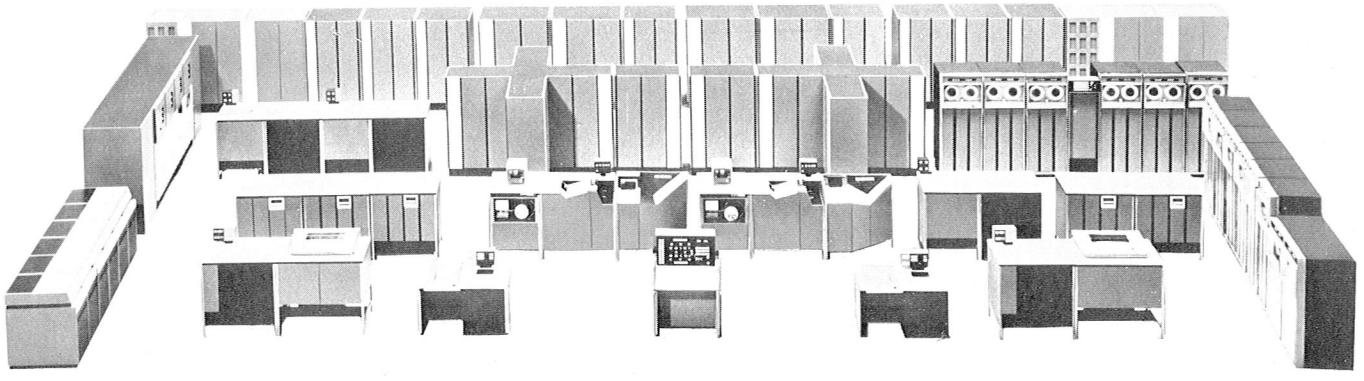

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INTRODUCTION

A computer, like any other tool used by man to tackle a task or problem, is limited in the extent to which it can be applied efficiently. A lightweight truck will probably break down if loaded considerably beyond its design limit. Likewise, a steam shovel is not the economic solution to digging postholes. A modular tool, however, can be applied to a wider range of jobs more efficiently. If the tool has several dimensions, each of which can in turn be modularized, the facility with which it can be tailored to handle specific jobs is enhanced even further.

This is how Nippon Electric Company (NEC) has tackled the problem of matching computers to specific data processing requirements. By breaking computer capability into basic dimensions and providing a range of capability in each dimension, NEC is uniquely able to match a computer to a given job. Also, the computer can be expanded or modified very easily to match changes in system requirements. This approach to computer system design is the basis of NEAC-Series 2200.

NEAC-Series 2200 represents an "off-the-shelf" processing capability consisting of processing, input/output and software modules that can be brought together in virtually any combination to form systems accurately tailored to solve any business or business-related data processing problem economically. NEAC-Series 2200 includes nine compatible processors which display outstanding cost/performance characteristics and offer the user great flexibility in his choice of speed, simultaneity and memory capacity. A broad array of input/output devices, offered in several performance levels, provide many input/output media alternatives. Software systems are tailored to match the modularity of hardware. Briefly, NEAC-Series 2200 features are :

PROCESSING DIMENSION

- Memory speeds ranging from 2 microseconds to 63 nanoseconds per character.
- Memory capacities ranging from 2,048 to 2,097,152 characters, in modular increments.
- Up to 15 index registers per program; flexible nanosecond control memory.
- A universal set of powerful instructions affording program compatibility between processors.
- Advanced programming and memory addressing methods, plus editing, and multiply/divide operations.
- Powerful floating-point capability.
- Extensive multiprogramming capabilities including memory address relocation.
- Multiprocessor System – Model 700 is provided with two central processors which commonly use the same main memory and the peripheral equipment.
- Fail Soft System – With an additional configuration control unit, the main memories and input/output trunk can be switched over by means of programmed control.

INPUT/OUTPUT DIMENSION

- Up to 128 peripheral control units connected to a processor; each accommodates one or several peripheral devices and is equipped with an automatic program interrupt facility.
- A wide variety of peripheral equipment available in a range of performance capabilities, including communication devices, card equipment, magnetic tape and paper tape units, mass storage units, high-speed printers, optical character reader and memory-to-memory unit.
- Broad-scale real-time capability that includes an efficient interrupt facility, communication controls (accepting data from up to 256 lines simultaneously), multilevel code handling, and a wide range of remote terminal facilities.
- Either 6- or 8-bit information transfers between main memory and certain peripheral controls.

SOFTWARE/CONVERSION DIMENSION

- Easy-to-use, compatible programming languages; powerful assembly and compiler systems.
- Wide array of generalized data manipulation programs; sorts, I/O packages, report generators and others.
- Instruction and data compatibility with IBM 1401, 1410, 1440, 1460 and 7010 systems.
- Liberator software for fast and easy program conversion.
- EASY Programming System ... which provides flexible job-oriented software modules employing self-loading for use in small business, paper-tape oriented installations.
- OS MODI MSR ... designed for foreground/background multiprogramming with complete memory protection and task-sensitive job scheduling for medium-sized systems using mass storage files.
- OS MODI TR ... which provides semi-centralized, automatic control for medium-scale magnetic tape installations.
- OS MODI EXTENDED ... which includes all functions of MODI MSR/TR with addition or expansion of functions of multiprogramming processing and on-line real-time processing for the thorough demonstration of medium-sized or large-sized systems.
- OS MODIV ... provided with functions of multiprogramming and dynamic allocation of materials (computer memory, peripheral equipment) for the maximum demonstration of processing capability of large-sized systems. By making use of memory protection function of hardware, simultaneous processing of the independent programs is possible up to a maximum of 20 with any combination of batch processing, data conversion processing, real-time processing or remote batch processing.
- OS MODIV EXTENDED ... which is an extended form of MOD IV with the system configuration based on the high-speed magnetic drum unit. When required, the system is configured based on the magnetic drum. Speed of program reading can be improved and the system overhead is reduced.
- OS MOD VII ... newly developed operating system for multiprocessor system. Making the best use of this system, MOD VII is designed for the effective use of materials (common use of the same memory unit, common use of files, etc.) and the improvement of reliability (common diagnostic function, easy removal of impeding equipment).
- Application Systems ... which assist directly in the performance of functions that are part of a user organization's operations.

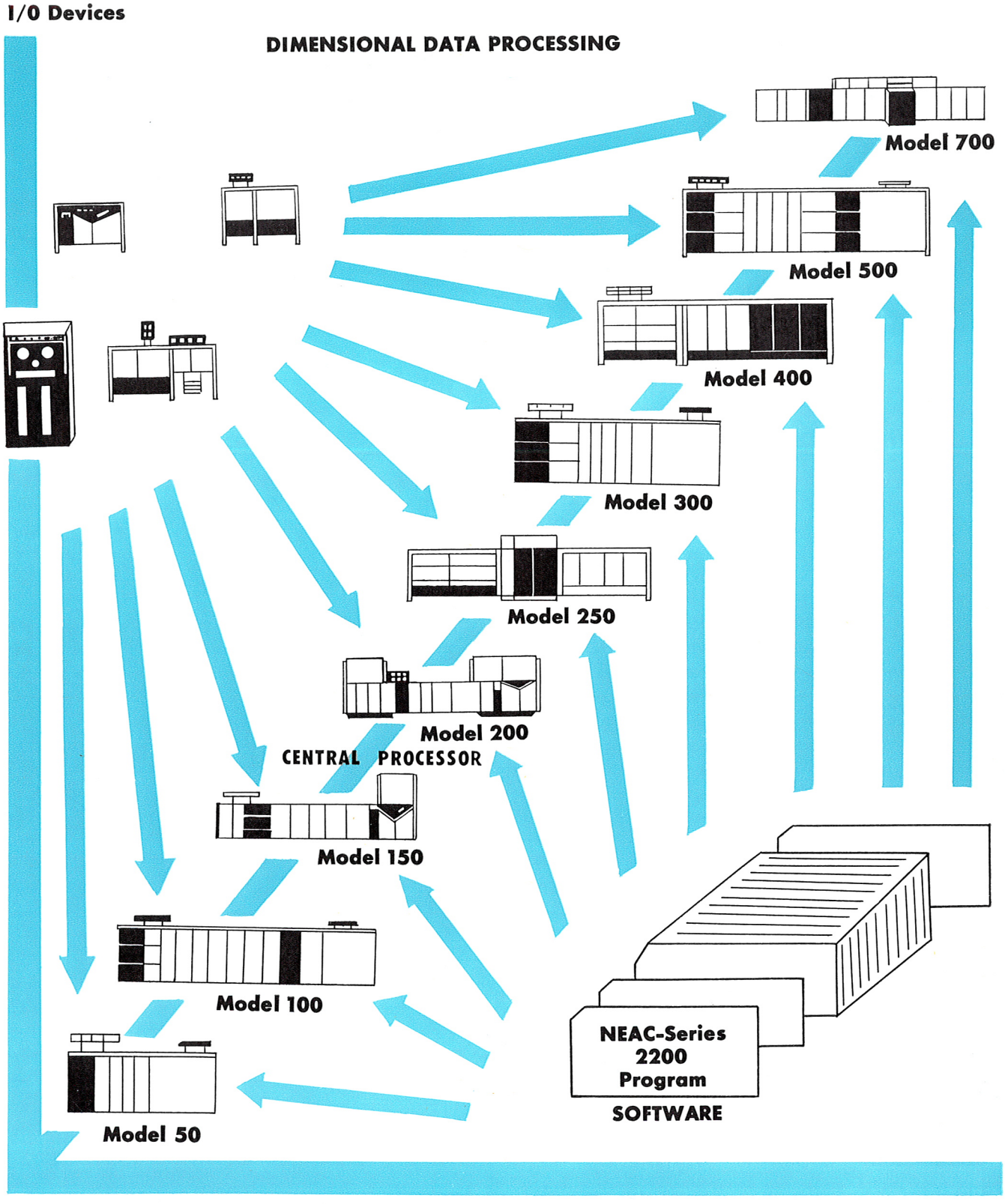
Clearly, NEAC-Series 2200 meets the needs of business data processing today – and tomorrow as well.

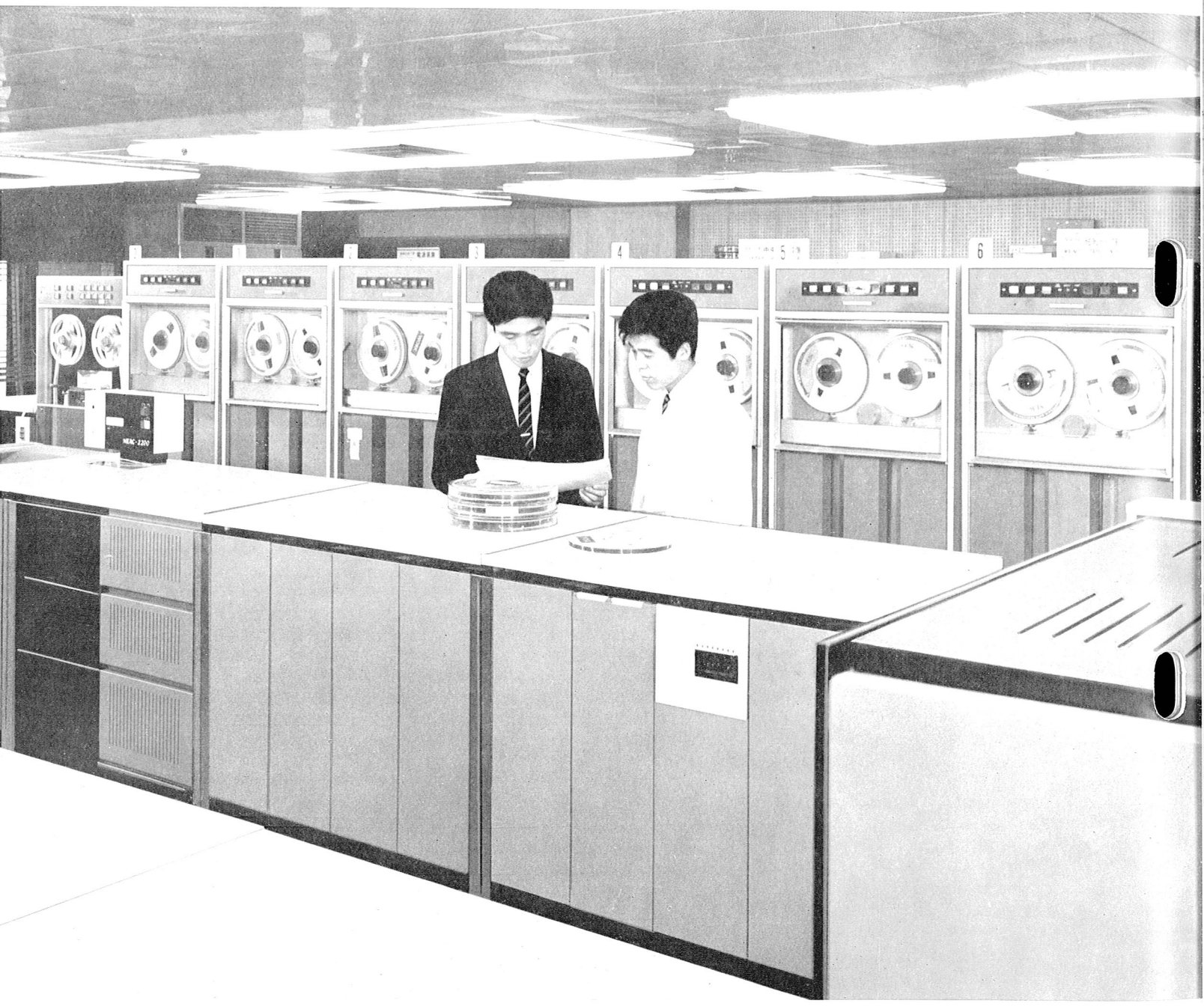
"One Machine Concept" Dream is made an actuality by NEAC-Series 2200

DIMENSIONAL DATA PROCESSING

The NEAC-Series 2200 is a dimensional electronic data processing system following through with the one machine concept.

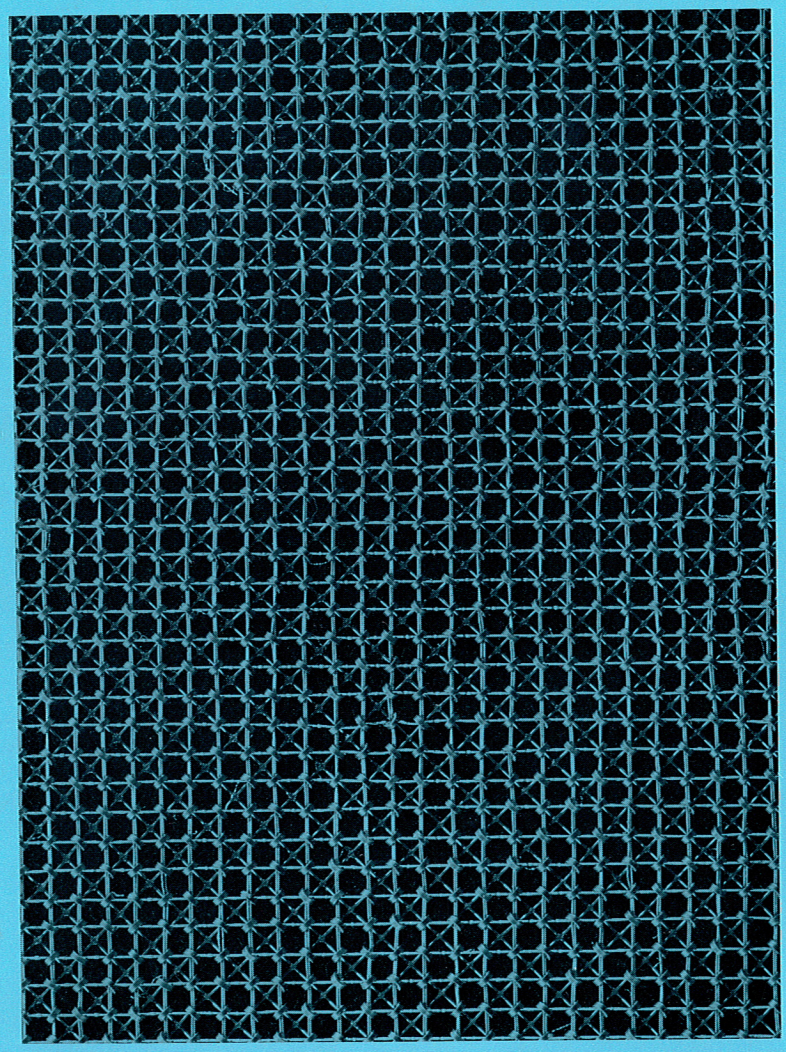
The NEAC-Series 2200 is uniquely able to present both the most economical and suitable system to a given job having three dimensions as shown in the table; central processor, input/output devices and software.





Processors

In keeping with design objectives, NEAC-Series 2200 processors constitute the central elements of a modular processing capability. The design of this new processor series is based on, but also fulfills and complements, the NEAC-Series 2200. The result is a line of nine powerful but economical models which are fully compatible and easy to use : Models 50, 100, 150, 200, 250, 300, 400, 500 and 700.



THROUGHPUT - KEYNOTE OF NEAC-SERIES 2200 PROCESSORS

NEAC-Series 2200 processors are designed primarily for business applications and for jobs involving combined business, data communications and scientific processing. In most data processing, the governing performance dimension is throughput – the quantity of data taken in, processed and transferred to output media as computed results. High throughput requires not only an ability to transfer a large quantity of data into and out of a processor, it also requires the capacity to process these data internally. This includes the performance of all required computations and manipulations, while at the same time servicing demands from input/output devices quickly enough so that these devices can operate at their rated speeds. Therefore, the internal speeds of the processor must be high enough to allow the required combination of computing and input/output servicing. Clearly, then, high-throughput processors must possess a good balance of internal speed and potential input/output demand. As the following discussion will demonstrate, NEAC-Series 2200 processors incorporate an optimally balanced mixture of computing power and peripheral simultaneity at all levels of overall throughput capability.

COMPUTING POWER

The ability of a processor to perform purely internal processing, involving only such operations as arithmetic, logical functions, data transfers and editing, is largely a function of: (1) the amount of memory available for storing programs, as well as control and working data; (2) control and main memory speeds, which govern the time required to obtain and move instructions and data within the processor; (3) the selection of instructions in the processor's repertoire and the efficiency of the logic by which instructions are implemented; and (4) the memory addressing scheme used. NEAC-Series 2200 processors provide computing power to meet the needs of any business jobs or applications involving business, scientific and communications processing.

MEMORIES - SPEED AND CAPACITY

High internal speeds are assured by main memory cycle times ranging from 2 microseconds to 63 nanoseconds per 6-bit character and control memory cycle times from 500 nanoseconds to 188 nanoseconds. For example, consider the following statistics, which are based on typical situations.

Operation	Execution Time, Microseconds		
	Model 50	Model 250	Model 500
Decimal Add	69.0	36.0	6.0
Compare	57.0	31.5	6.0
Branch on Condition Test	21.0	13.5	4.5
Move Characters to Word Mark	144.0	73.5	15.0
Floating Multiply	*	37.5	9.0

* Operation not available on this processor.

Three-character addresses are used to refer to five-character operand fields. Instruction access times are included in the times shown. The times for floating multiply refer to operations using a 36-bit mantissa and a 12-bit exponent.

The speeds of NEAC-Series 2200 memories are complemented by the wide range of storage capacities available at each speed level. Memory size in the Model 50 processor ranges from 4,096 to 16,384 six-bit characters. At the other end of the scale Model 700 processors are available with 131,072 to 2,097,152 character memories. The modularity of the NEAC system is exemplified by the relatively small increments in which main memory can be expanded, even at high capacity levels. Especially with Model 700, the main memories can be expanded up to 2,097,152 characters with 131,072 characters as a unit and can form a multiprocessing system provided with two central processors commonly using the same main memory. High-speed control memories of 16 to 128 control registers are used in all processors.
Information is stored in main memory locations either in pure

Processor Model	MEMORY CAPACITIES AVAILABLE (Thousands of characters)																								
	2	4	8	12	16	20	24	28	32	40	49	57	65	81	98	114	131	163	196	229	262	393	524	1048	2097
50		○	○		○																				
100	○	○	○	○	○	○	○	○	○																
150		○	○	○	○		○		○																
200		○	○	○	○	○	○	○	○	○	○	○	○												
250					○				○		○		○	○	○	○	○								
300					○				○		○		○	○	○	○	○								
400					○				○		○		○	○	○	○	○	○	○	○	○				
500													○				○		○		○	○	○		
700																	○				○	○	○	○	○

binary form, as 6-bit alphanumeric characters, or as signed decimal quantities. Any number of consecutive locations can be grouped to form fields; groups of consecutive fields can be delineated as items. Such groupings are defined by programmed or operator's setting of punctuation bits associated with each memory location. (Fields and items are defined, respectively, by word marks and item marks.) Punctuation bits can also be set to form a record, which is defined as any unit of information that is to be transferred between main memory and a peripheral device as the result of a single peripheral data transfer instruction.

Models 250, 400, 500 and 700 Central Processors, possess an 8-bit transfer capability in addition to the standard Series 2200 six-bit transfer. Certain specified peripheral control units can take advantage of this increased central processor flexibility. In the 6-bit mode, only the data portion of a character is transferred between main memory and the control unit. In the 8-bit mode, both data and punctuation are transferred between memory and the control unit. In this mode, record marks do not terminate the information transfer. Instead, transfers are terminated as specified by a count field in the information transfer instruction or by control characters associated with the control unit. This 8-bit transfer capability is available as Features 1121 and 1118A (Extended Multiprogramming and 8-bit Transfer) for Models 400 and 500. Models 250 and 700 possess such a facility as a standard feature.

There are no reserved input/output areas in main memory. The programmer has complete freedom in specifying the locations and sizes of such areas to meet the needs of any program. This allows both a high degree of programming flexibility and economical usage of memory.

A parity bit in each character position is used to maintain the accuracy of all data. Parity checking, performed automatically, is a method of checking a character each time it is moved in memory to insure that it retains its original meaning.

INSTRUCTIONS

NEAC-Series 2200 processors have available a repertoire of instructions which, with tremendous flexibility and power derived from the use of variant characters, can handle all arithmetic (decimal add/subtract, decimal multiply/divide, binary add/subtract, binary multiply/divide), logical, data move, control, shift, editing, and input/output functions necessary for business data processing. Also included in all processors are instructions for dealing with peripheral and communication interrupts and for manipulating data in codes of up to 12 levels. Hardware multiply and divide operations are standard in all processors except Models 50, 100 and 150. Models 200, 250, 300 and 400 can be equipped with a floating-point arithmetic facility for use in scientific applications; floating-point operations are standard on Models 500 and 700.

In addition, Model 700 is provided with all instructions which are possessed by other NEAC-Series 2200 models. It also has word-type instructions which handle integer, half integer, floating-point and floating-point double data, and will display its fullest functions in scientific calculations.

For all models up to Model 500, instructions are variable in length. The basic instruction format consists of an operation code which specifies the type of operation to be performed, two operand fields which specify the binary addresses of fields to be used in the operation and a variant character:

1.	Operation Code	A Address	B Address	Variant Character

The variants can be used to expand the meaning of the operation code or to specify literally a piece of data to be used in the operation. However, there are many times when not all of these instruction elements are needed, in which case they may be omitted to minimize both the amount of memory storage required and the time necessary to retrieve and execute an instruction. Peripheral control and input/output instructions have a slightly different basic format than the one described above. The various NEAC-Series 2200 instruction formats are illustrated in the following table.

2.	Operation Code	A Address	B Address			
3.	Operation Code	A Address	Variant Character			
4.	Operation Code	A Address				
5.	Operation Code	Variant Character				
6.	Operation Code					
7.	Operation Code	A Address	B Address	Variant Character 1	Variant Character 2	
8.	Operation Code	A Address	B Address	Variant Character 1	Variant Character 2	Variant Character 3
9.	Operation Code	A Address	Control Character 1	Control Character 2	Control Character n	
10.	Operation Code	A Address	Variant Character 1	Variant Character 2		
11.	Operation Code	Variant Character 1	Variant Character 2			

Besides these instruction formats, two new word type instruction formats have been made available for Model 700. These formats are of fixed word length and are used mainly for scientific calculation.

12.	Operation Code	Variant Character 1	Variant Character 2	Variant Character 3	A Address
13.	Operation Code	Variant Character 1	Variant Character 2	Variant Character 3	

Format 12 instructions are used for memory/accumulator operation and Format 13 instruction for inter-accumulator operation. These instruction sets are available for load/store, binary add and subtract, binary multiply and divide, logical operation, shift, and decision making which are performed at high speed.

MULTIPROGRAMMING

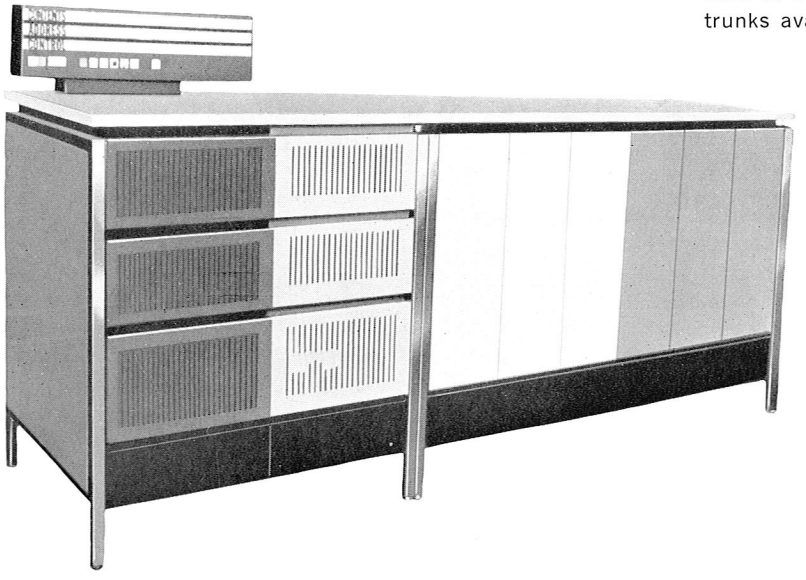
In a multiprogramming environment, it is necessary to have facilities to prevent active programs from altering information which is not relevant to their operation, to decide where new programs are to be loaded into main memory, and to allow certain high-priority programs to run without interruption. The Extended Multiprogramming and 8-Bit Transfer Feature provides the Model 400 and 500 processors with these facilities by including the storage protection with base relocation. Models 250 and 700 possess such a function as a standard feature.

The storage protection with base relocation capability consists of a relocatable, 2-fence barricade system. This system prevents the active program in main memory from writing into areas of memory which are not assigned to it. The lower fence is provided by the base relocation register and the upper fence by the index barricade register.

A monitor program keeps track of the locations of the various programs stored in memory and can relocate the active area of memory to any number of 4096-character banks of memory.

ADDRESSING

All NEAC-Series 2200 main memory locations are directly addressable. Three additional features facilitate advanced programming and addressing of large memories – indexed and indirect addressing and variable-length address interpretation. Six main memory index registers are provided as part of main memories having 32,768 or fewer storage locations; larger memories are equipped with 15 index registers per program. These registers provide an automatic means for address modification without altering the instruction in which the address is modified. Indirect addressing enables the user to reference stored information via one or more intermediary addresses. Variable-length address interpretation refers to the ability of NEAC-Series 2200 processors to operate in three different address interpretation modes, allowing the programmer to code instructions using either two-character, three-character or four-character addresses. This facility provides the flexibility necessary to allow the direct addressing of large memories, while at the same time saving processing time and memory space when working in localized areas of memory.



N150A Central Processor

SIMULTANEITY

The speed of internal processing is one of the most important standards in evaluating the total throughput of a system; peripheral simultaneity is the other. NEAC-Series 2200 processors possess several features which enable them to provide powerful but easy-to-use simultaneity: program-assignable read/write channels, multiple input/output trunks and an interrupt processing facility.

READ/WRITE CHANNELS AND INPUT/OUTPUT TRUNKS

The use of program-assignable read/write channels enables NEAC-Series 2200 processors to compute while concurrently servicing from 3 (Model 50) up to 24 (Model 700) input/output operations. In addition, Series 2200 processors provide facilities for interfacing with a large number of peripheral controls, ranging from a possible 8, in the case of the Model 50, up to 128 in the Model 700. The high internal speeds of these processors insure that even when the high degree of possible simultaneity is fully exploited, the increased demands on the processor to service peripheral devices will still be satisfied. Perhaps even more significant than the effect is the cause: this capacity is built into every NEAC-Series 2200 processor. It does not depend upon complex software or expanded system configurations.

Both Models 100 and 150 central processors are equipped with integrated control unit for N122A-1 line printer (500 lines per minute) ① N123 card reader (400 cards per minute) N123-2 card reader (600 card per minute) and N214-1 card punch (100~400 cards per minute) or ② N109-1 paper tape reader (300 frames per second), N110A-1 paper tape punch (60 frames per second) and N110A-3 paper tape punch (110 frames per second). The card devices can be separate or combined as a reader-punch. Also available is an integrated control for four non-simultaneous magnetic tape units (read/write speed of 13.3 KC/26.6 KC). Connections of all other peripheral controls to NEAC-Series processors is made via input/output trunks. The number of such trunks available in a processor ranges from 8 in the Model 50 to 128 in the Model 700. A control unit which handles both reading and writing (e.g., a magnetic tape control) connects to a pair of trunks. The number of peripheral controls possible in a system depends only on the number of input/output trunks available.

NEAC-Series 2200 Processors Input/Output Characteristics

PROCESSOR MODEL	NUMBER OF I/O TRUNKS	NUMBER OF I/O OPERATIONS SIMULTANEOUS WITH COMPUTING	
		Standard	Maximum
50	8	2	3
100	5 – 11	2	3
150	8 – 11	3	4
200	8 – 16	3	4
250	16 – 32	4	6
300	16	4	4
400	16 – 32	4	8
500	32 – 64	8	16
700	64 – 128	16	24

Data are transferred between main memory and a trunk (and thus a peripheral device) via a read/write channel assigned by the instruction which initiates the transfer. A read/write channel is a data path across an interface between memory and a peripheral device. Whenever an input/output operation is to be performed, a program-assigned read/write channel completes the path between the required peripheral device and the main memory.

In central processors other than the Model 50, standard transfer rates of 83 KC – 500 KC are associated with each read/write channel. In the Model 50 central processor, the transfer rate is 167 KC.

The Model 700 central processors are provided with 16 standard read/write channels as with the Model 500's maximum configuration and 8 additional high speed read/write channels can be provided. By interlocking two or more high speed read/write channels, data can be transferred at such a high speed as 2 mega characters per second.

The degree of peripheral simultaneity achievable by any NEAC-Series 2200 processor depends upon the number of read/write channels with which it is equipped.

Twenty-four read/write channels are available in the Model 700, allowing a like number of input and output operations, in any combination, to go on at the same time as internal processing. In order to appreciate the full power of the read/write channel concept, consider the following statistics: In one minute, an NEAC-Series 2200 system equipped with a Model 150 processor having four (4) read/write channels can:

read 800 cards;
punch 10 columns of data into 400 cards;
print 1000 lines of 120 characters each;
read or write 4,360 tape records of 500 characters;

(or perform any combination of four I/O operations) and in the same minute, execute 1.25 million instructions.

INTERRUPT PROCESSING FACILITY

The NEAC-Series 2200 automatic program interrupt facility provides simple but efficient supervision of processing involving combinations of input/output operations and computing. This facility allows automatic branching as necessary between a main program and servicing routines for all input/output devices. It obviates the need for programmed tests to detect the completion of input/output operations. The automatic hardware interrupt has important applications in the field of data communications and other real-time areas, but it is equally applicable to the supervision of operations as universal as reading and punching cards and paper tape, as well as reading and writing magnetic tape.

The NEAC-Series 2200 interrupt processing facility consists of a hardware program interrupt, which signals a particular condition in an input/output control unit, and a set of instructions used in processing interrupts. A program interrupt occurs whenever a peripheral device has completed an input/output operation. For example, an interrupt occurs at the end of data transfer in a tape read or write operation. Likewise, the receipt of a character from a remote station by a communications control unit is signaled by a program interrupt. Interrupts from particular peripheral controls can be inhibited by a program as necessary.

A program interrupt is accompanied by: (1) automatic storage of main program indicator values, control register contents, and an indication of interrupt source; and (2) automatic branching to a routine whose address was previously loaded by program into a special control memory register. This routine can then proceed to determine the number and source of existing interrupts and to process the corresponding input/output demands according to whatever priority was specified by the programmer. The interrupt instruction subset is particularly helpful in this regard. After all demands have been processed, only a single instruction is necessary to resume the main program at its point of interruption and to restore all main program indicators and control registers to their previous values.

CONVERSION COMPATIBILITY

NEAC-Series 2200 processors are designed according to the Liberator concept, which allows the users of various competitive systems to take advantage of the superior performance of NEAC systems without incurring the prohibitive costs of reprogramming. For example, the instruction repertoire of NEAC-Series 2200 processors is similar enough to those of several other processing systems, viz., the IBM 1400 series, to allow automated, one-time translation of programs written for these competitive systems to a form suitable for execution on higher-performance NEAC-Series 2200 systems.

STRUCTURAL MODULARITY - RELIABILITY

A major feature of the structural design of NEAC-Series 2200 processors is the use of integrated system modules. Each module contains all the circuitry required for a particular system functions; for example, one module contains all the printer control circuitry, another contains the components of the arithmetic unit, etc.

This modularity greatly simplifies expansion of a system; in most cases, expansion involves little more than plugging in additional modules. The reliability of components within each module has been maximized through the use of silicon semiconductors. In addition, NEAC-Series 2200 takes advantage of the latest advances in the application of monolithic integrated circuits.

SUMMARY

NEAC-Series 2200 processors possess optimum combinations of high memory speeds, modular memory capacities, powerful instructions, efficient addressing methods, and flexible input/output traffic facilities which afford the computing power and simultaneity necessary for high throughput rates. The productivity of these processors is enhanced by their programming and operating simplicity. Basic hardware compatibility enables users of competitive systems to convert easily to take advantage of superior NEAC-Series 2200 performance. Sound hardware design, always an NEC plus, provides modularity and assures reliability. All processors are equipped with :

- Direct, indexed and indirect addressing
- 2- to 4-character address interpretation
- Program-assignable read/write channels
- Automatic program interrupt
- Multilevel code handling facility

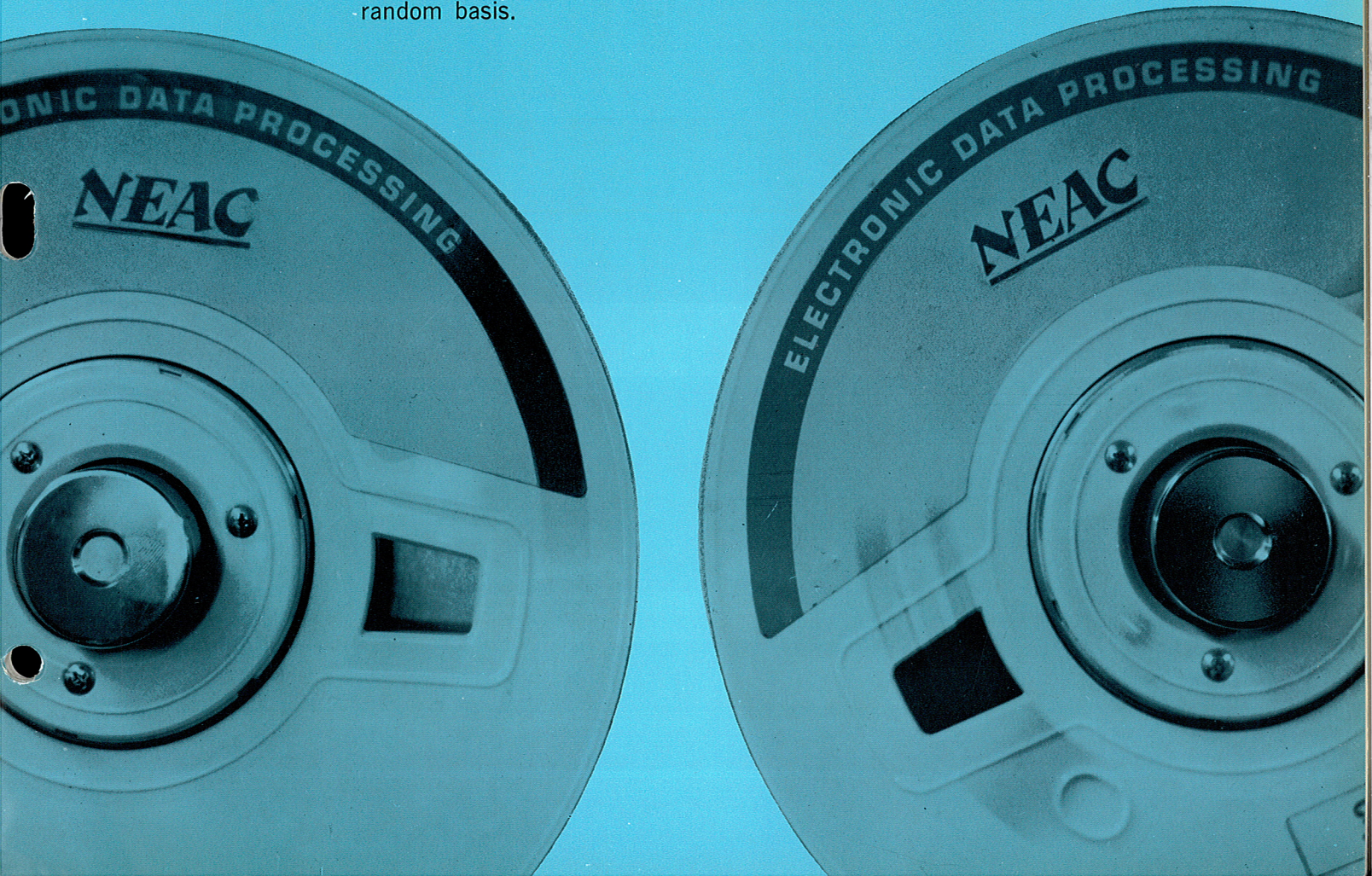
Other processor facilities are tabulated below :

* Features not available in this processor.

Processor Model	Main Memory Speed (Cycle time)	Memory Capacity (Thousands of characters)	Number of Input/ Output Trunks	Number of I/O Operations Simultaneous with Computing	Advanced Programming Instructions	Financial Editing Instruction	Multiply and Divide Instructions	Scientific Processing Instructions	Memory Protect Facility
50	2 μs	4 – 16	8	2 – 3	Option	Option	*	*	*
100	2 μs	2 – 32	5 – 11	2 – 3	Option	Option	*	*	*
150	2 μs	4 – 32	8 – 16	3 – 4	Standard	Standard	*	*	*
200	2 μs	4 – 65	8 – 16	3 – 4	Option	Option	Standard	*	*
250	1.5 μs	16 – 131	16 – 32	4 – 6	Standard	Standard	Standard	Option	Standard
300	1.5 μs	16 – 131	16	4	Standard	Standard	Standard	Option	Option
400	1 μs	16 – 262	16 – 32	4 – 8	Standard	Standard	Standard	Option	Option
500	188 μs	65 – 524	32 – 64	8 – 16	Standard	Standard	Standard	Standard	Option
700	63 μs	131 – 2097	64 – 128	16 – 24	Standard	Standard	Standard	Standard	Standard

File Storage Units

Equipment used in computer systems to store program and data files should have the following characteristics: large storage capacity, efficient packing of data on the storage medium, access time and data transfer rate commensurate with the application(s) being performed, and adequate data protection facilities. For those applications requiring high reliability, large storage capacity, economical use of storage medium and using serial file access techniques, NEC offers its line of industry-acclaimed, vacuum-operated magnetic tape drives. Random access file units are provided for use in situations such as may occur in data communications and other real time applications, where file references must be made quickly on a random basis.



PERIPHERAL CONTROLS

Peripheral controls are used to regulate the transfer of data between a processor and file storage units. A significant feature is the fact these controls operate independently of the central processor and require memory access only when information transfers are performed. In particular, all data validity checks, such as parity checks in magnetic tape transfers, are performed by the controls and do not involve the central processor in any way.

Controls for 24/48-inch-per-second magnetic tape units accommodate up to four drives. Control units for 1/2-inch magnetic tape units and random access are each connected to a processor by means of two input/output trunks and can accommodate up to eight devices. The number of tape unit and random access file controls in a system is limited only by the number of input/output trunks available. Switching units (Model N205) are available to allow alternate connection of one or more tape units to different control units. Also, both tape and random access file controls can be switched between NEAC-Series 2200 processors by use of Model N216, N216A-1 or N216A-2 peripheral control switching units.

MAGNETIC TAPE UNIT

Two complete families of magnetic tape units are provided for use in NEAC-Series 2200 systems:

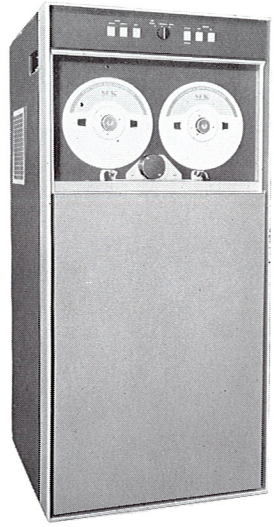
Units which process 1/2-inch tape provide: (1) The standard means for storing 6-bit data; and (2) IBM compatibility, including end-of-file mark recognition and the ability to translate between card images in IBM even-parity tape code and NEAC-Series 2200 processor code.

Programmed tape operations of 1/2-inch tape units include the following - read forward, write forward, backspace one record, space forward one record, rewind, rewind and release and erase; also available is read backward.

As indicated in the accompanying table, data transfer speeds range from 7,200 to 96,000 characters per second for units processing 1/2-inch tape. Also included in the table are "cross-gap" times, the presence of which points to a distinct advantage of NEAC tape units. When a tape read or write operation is completed, the tape unit begins a deceleration interval which is coincident with the creation of part of the inter-record gap on tape. However, it is not necessary for the unit to stop before beginning to execute a new read or write operation. In such an operation is begun at any time during the deceleration interval, the unit merely accelerates, completes the inter-record gap, and begins the next operation.

The power of NEAC-Series 2200 peripheral simultaneity is evidenced by tape processing statistics: The proportion of available central processor time during a data transfer interval shared with a tape read or write operation ranges from 75% to more than 99%, depending upon the data transfer rate of the tape unit and the speed of the processor being used. Simultaneity is further increased in the case of 1/2-inch tape units: Reading and writing can proceed simultaneously under the direction of a single tape control unit at the same time that computing is in progress (13.3/26.6 KC magnetic tape drives do not have this facility).

The design of all NEAC tape units incorporates the vacuum techniques which have earned an outstanding reputation for error-free operation. Vacuum control is used to mount, drive and stop the tape so as to avoid any danger of damage; the reading surface of the tape has physical contact with the



N204B Magnetic Type

Summary of Magnetic Tape Unit Speeification

Rend/Write Speed	16 in./sec.*	24 in./sec.**	36 in./sec.			48 in./sec.**	80 in./sec.			12 in./sec.	
RYcONDING DEUSITY Char./in.	556	556	200 556	200 or 556 800 800	800	556	200 556	200 or 556 800 800	800	200 556	556 800
TRANSFER RATE KC./sec.	8. 9	13. 3	7. 2 20. 0	7. 2 or 20. 0 28. 8 28. 0	28. 8	26. 6	16. 0 44. 4	16. 0 or 44. 5 64. 0 64. 0	64. 0	24. 0 66. 7	66. 7 96. 0
REWIND SPEED in./sec.	72	72	108			144	240		240	360	
INTER-ROCORD GAP	. 45″ . 75″	. 45″ . 75″	0. 45″ 0. 75″		0. 60″	. 45″ . 75″	. 60″ . 75″		0. 60″	. 70″ . 75″	
CROSS-GAP TIME	28. 1 ms 46. 2 ms	18. 7 ms 31. 2 ms	12. 5 ms 20. 8 ms		16.7 ms	9. 3 ms 15. 6 ms	7. 5 ms 9. 4 ms		7.5 ms	5. 8 ms 6. 3 ms	
NUMBER OF TRACK	7	7	7		9	7	7		9	7	
MODEL 1	E204	N103 N204B-12	N204B -1, -2	N204B-7	N204C -13	N103B N204B-16	N204B -3. -4	N204B-8	N204C -15	N204B-5	N204B-9

* Availiable only with the M-50.

** N103 and N103B consist of the Magnetic Tape Unit (N204B-12 and N204B-16) and its Control Unit. They can be connected with three additional N204B-12 and N204B-16, respectively. N103 and N103B are available only with the Models 100 and 150.

read/write head only. A write-enable ring and a manual tape unit switch guard information on tape from accidental destruction by an unintentional write operation.
All information written on 1/2-inch tape is immediately read and checked. During a write operation, a parity bit is generated for each frame and another is generated for each data channel. The parity bits accompany the data on tape. Frame and channel parity are checked while reading. Failure of any of these checks automatically causes an indicator to be set which can be tested by a programmed instruction. The two (2) types of 9-track magnetic tape equipment are also available (N203C-13 and N203C-15).

DIRECT-ACCESS DEVICES

NEC's direct-access devices offer a well-balanced array of high-speed storage media designed to complement the main memory capacities of Series 2200 central processors. A complete line of direct-access devices is the logical solution to data storage and retrieval problems. NEC's direct-access equipment offers both the large storage capacity and instantaneous access required to accomplish many of the tasks assigned to an NEAC-Series 2200 central processor.
Direct-access storage devices fall into three general categories: disk pack drives, disk files and drums. While each of these categories has characteristics and capabilities that are unique to a particular device, they all provide low-cost, high-capacity data storage capabilities and allow extremely fast data retrieval.

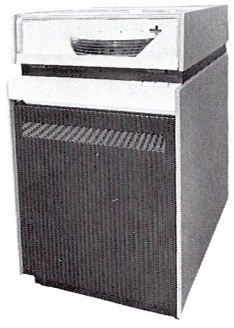
DISK PACK DRIVER

The NEC direct-access family features nine types of disk pack drives - Types E261, N259, N273B, N274A-1, N274A-2 and N274B. The on-line storage capacity of NEC disk pack systems ranges from 0.8 million data characters (E261) to 280 million data characters (N274B). A complete disk pack system consists of one or more disk pack drives and a disk control.
The Type E261 Disk Pack Drive is a low-cost, high-performance small-capacity product and is used with NEAC-Series 2200 Model 50 system. It has made it possible to configure disk pack system for small-scale computers.
Both N259 and N273B Disk Pack Drives consist of one disk pack module, and are used with NEAC-Series 2200 Model 100 and larger models. They can configure disk pack systems having capacities of 4.6 MHz to 73.6 MHz. An N4005 Disk Pack consisting of six disks is used for these drives.
Of the N274A-1, N274A-2 and N274B Multi-Spindle Disk Pack Drive, the N274A-1 consists of 16 disk pack modules; the N274A-2, 8-disk pack modules; and the N274B, 9-disk pack modules. They are all-round on-line memories featuring large capacity, and high-speed access and high-speed data transfer capabilities.
In addition to the high-speed access capability of the modules, these disk pack drives can perform sequence operations up to 16 modules or 8 modules at the same time. In the N274B, one out of 9 modules is used as a stand-by module. Besides this, if an additional control unit is used, an additional data transfer circuit can be provided to cross-call the modules and, as a result, a filing system having excellent processing capability can be formed. Besides improving the processing efficiency, they also have complete functions - such as disconnection, repair and resetting - against a failure which are required with the real-time system.

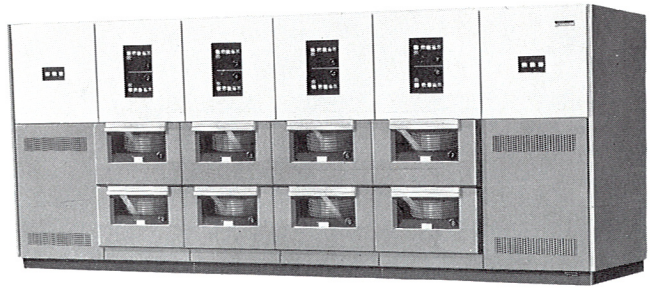
The control unit regulates the transfer of data between the control processor and the disk pack drive by providing temporary storage for each character transferred. The control also performs all checks on the data transfer operation and continually monitors the status of the disk pack drives. Up to seven seek operations can be performed simultaneously with a read or write operation by a single control unit. Data protection consists of a validity check for reading operations and verify reading and file protection for writing operations.

Summary of Disk Pack Drives Specifications

Type	E261	E259	N273B	N274A-1	N274A-2	N274B
Description	Disk Pack Drives			Multi-Spindle Disk Pack Drives		
No. of Pack/Units	1	1	1	16	8	8+1
No. of Arm/Packs	8	10	10	20	20	20
No. of Cylinder/Packs	64	200	100	200	200	200
Capacity/Pack (Mega Char.)	0.8	9.2	4.6	18.4	18.4	35.0
Capacity/Unit (Mega Char.)	0.8	9.2	4.6	294.5	147.2	280.0
Transfer Speed (kHz/sec)	83	208	208	208	208	416
Average Seek Time (millisec)	250	110	40	50	50	50
Average Latency Time (millisec)	14.3	12.5	12.5	12.5	12.5	12.5
Unit/Control Unit	4	4	4	1	2	2



N259 Disk Pack



N274 Multi-Spindle Disk Pack

RANDOM ACCESS DISK FILE AND CONTROL

The Type N261, N262 Disk Files are fixed-disk storage devices which provide an extremely high on-line storage capacity for an NEAC-Series 2200 system. These Disk Files are connected with the N260 Disk Control which in turn is connected with

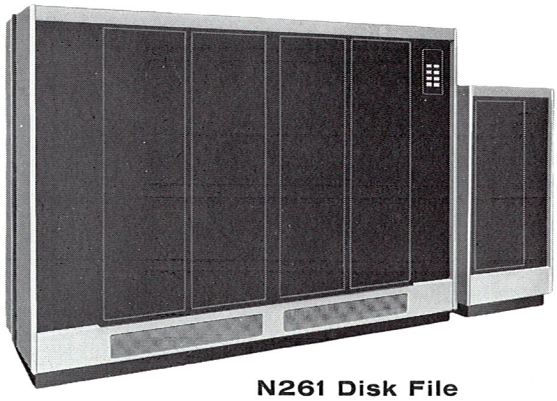
two input/output trunks of the NEAC-Series 2200 central processor, and control a maximum of eight N261 Disk Files or four N262 Disk Files. In addition, the N260 Disk Control can control a maximum of eight units consisting of any desired numbers of the N261 and N262 Disk Files. In such a case, an N262 Disk File is counted as two units.

The 260 control unit regulates and checks the data transfer as well as monitoring the status of the Disk Files. Up to seven seek operations can be performed simultaneously with a read or write operation by a single control unit. Data protection consists of a validity check for reading operations and verify reading and file protection for write operations. The design of a Disk File allows access to 1.0 million characters without read/write head movement. Another 1.0 million characters are available in 15 milliseconds.

An 8-bit transfer capability, which is available when the N260 control with Feature N077 is attached to an N261, and N262, allows data to be transferred in the 8-bit transfer mode in addition to the standard NEAC-Series 2200 six-bit transfer mode. Data recorded on the magnetic tape are of variable length and they, each having an address, are memorized. The recording is easily performed by giving a parameter to the control program.

Summary of Disk File Specifications

Type	N261	N262
Memory Capacity	1.3 billion words	2.6 billion words
Seek Time	25~120 mm/sec.	25~120 mm/sec.
Latency Time	25.7 mm/sec.	25.7 mm/sec.
No. of Cylinders	128	256
No. of Disks	36	72
No. of Disk Faces Used	64	128
No. of Trucks/Disk Face	256	256
Data Transfer Speed	188,000 char./sec.	188,000 char./sec.
Unit/Control unit	8	4



N261 Disk File

RANDOM ACCESS DRUM AND CONTROL

The Magnetic Drum is available in four models - the types E271, N271, N271A and N271B.

One to eight drum files can be connected to a control unit to operate on-line in an NEAC-Series 2200 system.

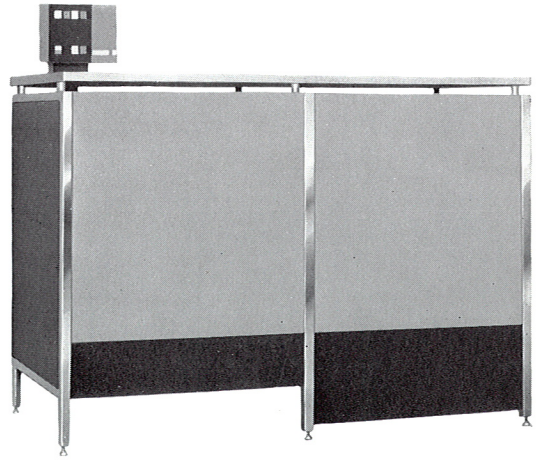
The E271 Drum Unit is an economical small-capacity drum developed for the NEAC-Series 2200 Model 50 and four E271 units can be connected with an N270 drum control unit for various small-scale system applications.

Eight N271 and N271A Drum Units can be connected with an N270 and N270A Drum Control, respectively. They are used with the Model 100 and larger capacity models, and, since no seek time is required, are very effective for the real-time system, the turn around time of which is very important.

The N271B Drum Unit was developed for the NEAC-Series 2200 Model 700, and features high-speed access time [17.1 ms (60 Hz)] and high-speed data transfer.

The record stored in the N271B Drum is of variable length as with the N-type Disk Unit and its programs are compatible with those of the Disk Control. Therefore, the N271B is used for system file requiring high-speed access and high-speed data transfer. It is also used to memorize data which are very frequently used on real-time base, and for the roll-in and roll-out of the time sharing system (TTS). The drum control automatically generates a parity bit for each character to be written. The parity bits accompany the record onto the drum. An automatic character parity check is performed while reading; any discrepancy results in the setting of a program-accessible indicator.

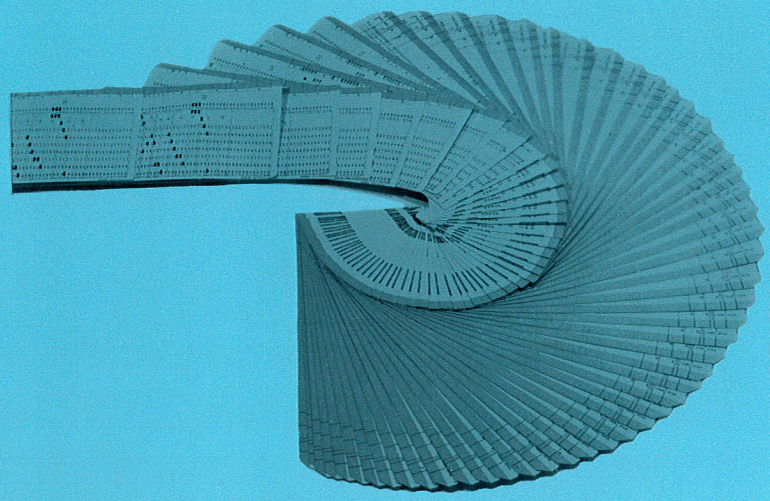
Type	E271	N271A	N271	N271B
Memory Capacity	81,900 char.	327,000 char.	2,621,000 char.	1,700,000 char.
Average Access Time	8.3 ms (60 Hz) 10.0 ms (50 Hz)	8.3 ms (60 Hz) 10.0 ms (50 Hz)	27.5 ms	17.1 ms (60 Hz) 20.7 ms (50 Hz)
No. of Trucks	64	256	512	512
Data Recording System	Fixed length, 128 or 48 char. per sector	Fixed length, 128 or 40 char. per sector	Fixed length, 128 char. per sector	Variable length
Data Transfer Speed	103,000 char. per sec (60 Hz) 85,000 char. per sec (50 Hz)	103,000 char. per sec (60 Hz) 85,000 char. per sec (50 Hz)	106,000 char. per sec	900,000 char. per sec (60 Hz) 750,000 char. per sec (50 Hz)
Unit Control Unit	4	8	8	4



N271 Magnetic Drum

Input/Output Devices

The NEAC-Series 2200 includes a wide variety of input/output devices to enable use of numerous input/output media. The following devices are offered: card readers, card punches, a card reader/punch, printers, paper tape readers, paper tape punches, communications control units (discussed in a succeeding section), and an operator's console. Most input/output devices are offered in several performance levels, allowing the user to choose a desired input/output medium at an economical processing level. Particularly significant is the fact that any of the devices described here can be connected to any NEAC-Series 2200 processor, contingent only upon the availability of the requisite input/output trunk(s). Thus, a great deal of flexibility is provided to allow accurate tailoring of system capabilities to satisfy user requirements.



PERIPHERAL CONTROLS

As in the case of file storage units, transfer of data to and from the central processor is regulated by independent peripheral controls which require memory access only briefly when information is actually being transferred; each device described here requires its own individual control (i.e., multiple devices cannot be connected to common control). All data-protection measures, such as validity and echo checks, are performed by the controls and do not involve the central processor.

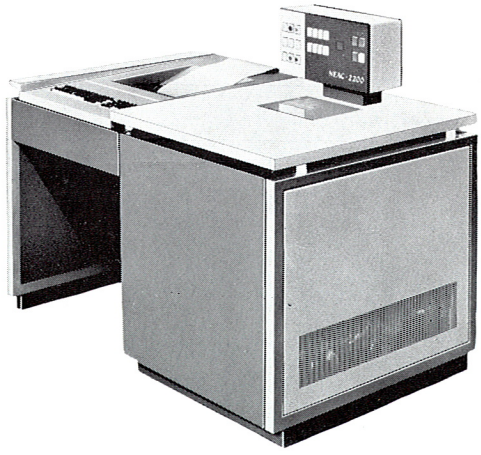
Models 100 and 150 central processors include controls for: (1) either a card reader/punch or separately, a 400 cpm card reader and a card punch; and a line printer; (2) paper tape reader/punch and a line printer. Ctherwise control units for input/output devices are each connected to processors by means of one or more input/output trunks. With two exceptions, each of the devices described here requires only one trunk; consoles and the reader/punch each require two. Input/output devices can be switched between NEAC-Series 2200 processors by use of Model N216, N216A-1 or N216A-2 peripheral control switching units.

CONTROL PANEL AND CONSOLES

A prospective NEAC customer can choose one of three devices for overall control of an NEAC-Series 2200 system: a control panel or one of two operator's console models. All devices provide a visual indication of system status and permit manual intervention into system operation.

The control panel, which is actually an integral part of the central processor, contains various control switches by which the operator can start and stop the machine and can load and interrogate both main and control memory locations. Sense switches may be used in conjunction with programmed instructions to stop processing or to select predetermined program paths, thereby increasing the flexibility of a program. The Type N220-1 console contains a console typewriter, which may be used as a peripheral device, operating under program control, or as a logging typewriter. The central processor control panel is used in conjunction with the Type N220-1.

In the Type N220-3L and N220-4L consoles, most of the control panel functions, including direct access to the central processor, are performed by means of the console typewriter. In addition, the typewriter can perform the peripheral and logging operations described above. The standard control panels are replaced in the Type N220-3L and Type N220-4L with a smaller version containing only the main power switches, sense switches and certain check condition indicators.



N220-3L Console

CARD EQUIPMENT

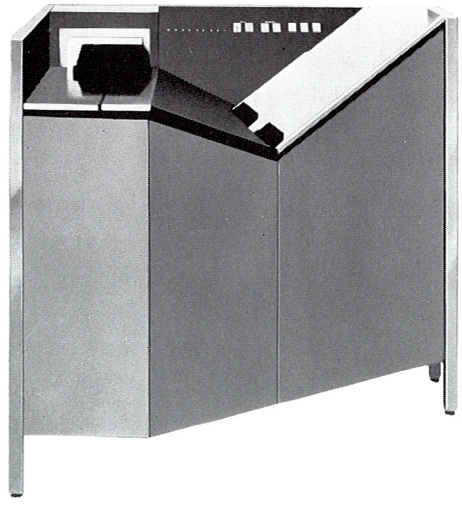
In keeping with the concept of modular processing capability, NEC offers a flexible array of punched card equipment. The units described are recent NEC developments and include such advanced card handling techniques as column-by-column (end-feed) processing. End-feed card processing provides four important advantages:

(1) It simplifies the reading and punching of cards containing nonstandard numbers of columns; (2) it enables accelerated feeding over columns not being punched; (3) it frees the central processor for other operations during a very high proportion of card equipment cycle time; and (4) it enables the complete elimination of card cycle clutch points. In card devices employing clutch points, a card input/output instruction can only be acted upon at certain points in the cycle, a situation which limits the device's throughput. The use of end feeding in all NEAC-Series 2200 card equipment enabled NEC engineers to incorporate demand feeding, i.e., the execution of card input/output instructions immediately upon their receipt by the pertinent control unit. Demand feeding, in combination with the ability to accelerate over unused card fields, provides maximum rates for continuous card reading and punching.

Automatic translation between standard 12-bit Hollerith card code and NEAC central processor code is a standard facility on all NEAC-Series 2200 card devices. Transcription mode reading and punching are also available on all devices.

CARD READERS—400, 600, 800 AND 1050 CPM

Four high-performance devices are offered for use in NEAC-Series 2200 systems to optically read 80- or 51-column punched cards; a 400-card-per-minute reader, Type N123, available only with the Model 100; 600-card-per-minute reader, Type N123-2, available only with the Type 150; 800 card-per-minute reader, Type N223, and 1050-card-per-minute reader, Type N223-2. Processed cards are sent to an output stacker, and those which fail data-protection checks can be offset-stacked under program control. Solid-state electronic components are incorporated in both card reader models to ensure optimum reliability. The speed, simplicity and reliability of these devices combine to give them the best cost-performance ratios in the industry.



N223-2 Card Reader

CARD PUNCHES—400, 250 AND 100 CPM

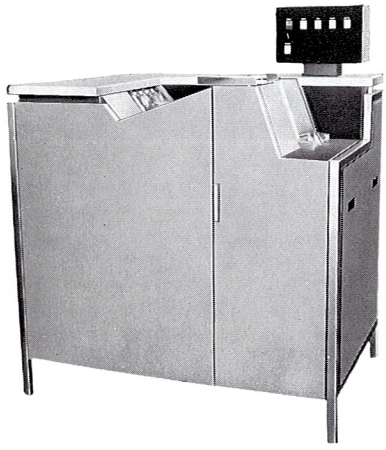
NEC provides three models of card punches, the Type N214-1 at speeds of up to 400 cpm, the Type N244A-1 at 100 cpm and the Type N224A-2 at 250 cpm. The speed of the Type N214-1 card punch, which is up to 400 cpm, depends upon which column is punched last.

This device also incorporates another new feature, dual-character punching, which employs a dual-die mechanism to punch two characters (columns) simultaneously and adds significantly to the high speeds and reliability of the unit. The Model N214-1 punch was designed for maximum reliability with minimum periodic maintenance. There are no cams or sliding parts in the feed mechanisms, making lubricating points completely unnecessary.

Punching errors are detected by a punch check; recognition of an error causes a program-accessible indicator to be set. The Type N224A-1 and the Type N224A-2 card punches operate at speeds of 100 cards and 250 cards per minute, respectively. The punched data is hole-counted to check its accuracy by read-station. Recognition of hole-count error causes a program-accessible indicator to be set.

400 CPM CARD READER/PUNCH

This dual-purpose device actually has three operational models; it reads, punches, or reads a card and punches additional information into the card on the same pass. Punching speed ranges up to 400 cards per minute, depending upon which column is punched last. Operating speed is 400 cards per minute when reading only; if reading and punching during the same pass, the unit operates at its punching speed. This device combines all of the advanced features of the readers and punches described above. That is, the punch station employs dual-character punching, as well as high reliability due to the absence of wear-producing cams, gears and sliding parts. The reading station features optical techniques. The reading and punching stations detect errors by means of illegal punch checks and punch checks, respectively. When a discrepancy is sensed, a program-accessible indicator is set, and the card can be offset-stacked.



N244 Card Punch

TYPE	CARD READER			CARD PUNCH				CARD READER/PUNCH	
	N123	N123-2	N223	N223-2	N214-1	N224A-1	N224A-2	E214*	N214-2
READING SPEED	400 cpm	600 cpm	800 cpm	1050 cpm	—	—	—	400 cpm	400 cpm
PUNCHING SPEED	—	—	—	—	100~400 cpm	100 cpm	250 cpm	100~400 cpm	100~400 cpm
PROGRAMMED OPERATIONS	1. Read data and transfer to specified memory area 2. On error card, offset-stack cards or go busy				Punch data from specified memory area			1. Punch data from specified memory area 2. Read data and transfer to specified memory area 3. Read/Punch same card	
DATA TRANSFER[1] MODE	Automatic translation between Hollerith card code and 6-bit central processor code is standard. Additional transcription mode reading and punching capacity also available.								
DATA PROTECTION	Illegal punch check Cycle check				Punch check	Hole-count check		Illegal punch check on Reading Punch check on Punching	
INPUT HOPPER/OUTPUT STACKER CAPACITY	3000/2500				1200/1300	1000/1500	1000/1500	1200/1300	

* The N123 is connected only with the Model 100 and the E214 with the Model 50.

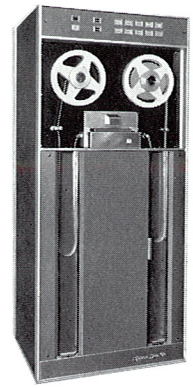
PAPER TAPE EQUIPMENT

There are four models of paper tape readers, E209, N109A-1, N209A-1 and N209A-2, which process 5-through 8-level tape at the rate of 300, 300 and 1000 frames per second, respectively.

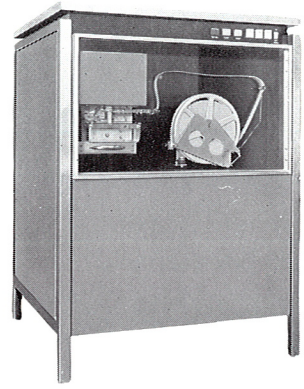
While, as paper taper tape punch five models are provided – N110A-1, N210A-, E210, N110A-3 and N210A-3.

The first two models punch a tape of the same level at a speed of 60 frames/sec while the last three models punch the same tape at a speed of 110 frames/sec. Tape stops within the length of a frame at the end of a reading or punching operation, thus ensuring reliable reading of the first and last frames in a record. Paper tape control units can be conditioned by programmed instruction to process either codes of 5- and 6-levels or codes of 7- and 8-levels.

This facility minimizes the amount of central processor time required for data transfer when processing 5- and 6-level tape. Frame parity can be generated by programmed instruction in preparation for punching. Likewise, frame parity can be checked by the program when reading tape. The reader can also be equipped to check each frame for odd or even parity and to set a program-accessible indicator if this check fails.



N209A-2 Paper Tape Reader



N210A-3 Paper Tape Punch

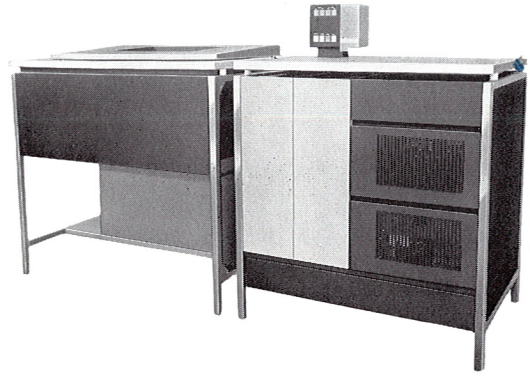
	PAPER TAPE READER				PAPER TAPE PUNCH				
TYPE	N209*	N109A–1	N209A–1	N209A–2	N110A–1	N210A–1	E210*	N110A–3**	N210A–3
READING SPEED	300 frames/sec			1000 frames/sec					
READING METHOD	Poto-electrical			sec.					
PUNCHING SPEED					60 frames/sec.		110 frames/sec.		
PUNCHING METHOD					Die-Punch				
TAPE RUNNING SPEED	30 in./sec.			100 in./sec.	6 in./sec.		11 in./sec.		
DATA FORMAT	(A) Domestic 6 levels (B) International 8 levels (C) International 6, 7 levels (D) International 5 levels			(A) Domestic 6 levels International 6, 7, 8 levels (B) Domestic 6 levels International 5, 6, 7 levels (C) International 5, 8 levels	Domestic 6 levels Domestic 8 levels		(A) International 8 levels (B) International 6, 7 levels (C) International 5 levels		
DATA PROTECTION	Parity check and Re-reading check								

* Connected only with the Model 50. ** Connected only with the Model 150.

HIGH-SPEED LINE PRINTERS

NEC offers high-speed printers to meet a wide variety of requirements. As indicated in the accompanying table, printing speeds offered range from 330 to 1000 single-spaced lines per minute. 120 or 132 print positions per line are available. Printing is performed in response to Peripheral Data Transfer instructions issued to the printer control from the central processor.
The Peripheral Control and Branch instruction is used to handle such functions as line or form spacing.
An edit instruction allows the programmer to arrange output data into any desired format.

During printing, the type roll on which characters are embossed moves past print hammers at each print position. Actuated as the proper character moves by, these hammers print the characters specified in the print instruction. The E206 High-Speed Printer is a chain printer for the NEAC-Series 2200 Model 50. A cycle check technique insures the accuracy of printed information.



N222-4 High-speed Printer

Summary of Printer Specifications

MODEL	E206*	N122A-1**	N206A-1	N206B-1	N222-4	N222D-4
PRINT SPEED	333 lpm 60 letters	420 lpm..... 109 letters 500 lpm..... 67 letters 1000 lpm..... 19 letters			750 lpm...63 letters 950 lpm...46 letters	633 lpm...46 letters 950 lpm...46 letters
PRINT POSITIONS PER LINE	120 or 132					
KINDS OF LETTERS	Numeric 10 Alphabetic 26 Kana letter 48 Special symbol 24	Numeric 10 Alphabetic 26 Kana letter 48 Special symbol 25			Numeric 10 Alphabetic 26 Special symbol 25 or Numeric 10 Kana letter 48 Special symbol 5	
SKIP SPEED (More than)	16.7 in./sec	25 in./sec			35 in./sec	
VERTICAL SPACING	6 lines per in.	6 or 8 lines per in.				
REMARKS	Chained			W/Buffer	Type font changeable	Optical Character Reader

* Available only on the M-50. ** Available only the M-100, M-150.

OPTICAL CHARACTER READER (N240D-1)

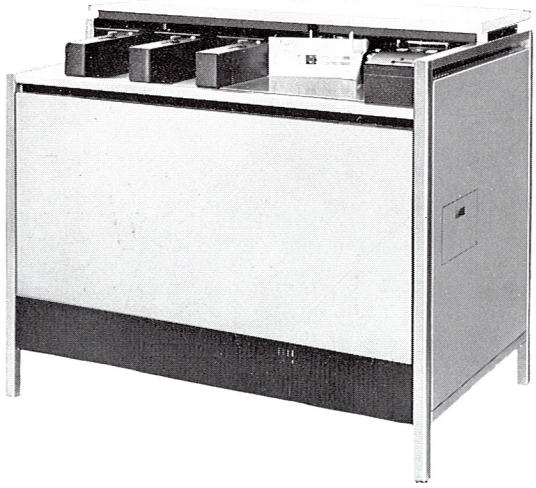
The Type N240D-1 Optical Character Reader optically reads input data printed by high-speed line printers or marked manually. As a recognition circuit, it uses a new circuit which was developed by incorporating the advantages of both conventional matrix matching and stroke analysis methods. This has resulted in a remarkable decrease of reject rate and has improved the reliability.

In addition, it reads 407 fonts, the standard type of the NEC high-speed line printer which is generally used. The cards used are designed to afford flexible application.

The Type N240D-1 Optical Character Reader can be connected on-line with the NEAC-Series 2200 computers to check and verify data completely.

Specifications of N240D-1

Card processing speed	600～1,100 cpm
Type of characters read	10 numerals and 5 special symbols
No. of read marks	10 or 12 positions/digit (Optional)
Card standards	Length : 3.0～3.9 in. Width : 3.5～8.0 in.
Hopper capacity	8.0 in. ×1
Stacker capacity	3.9 in. each ×3



N240D-1 Optical Character Reader

OPTICAL MARK READER (N240P-1)

The Type N240P-1 Optical Mark Reader is an input unit which lets the computer directly read data written in English, numerals and Japanese kana characters by pencil on specified formats.

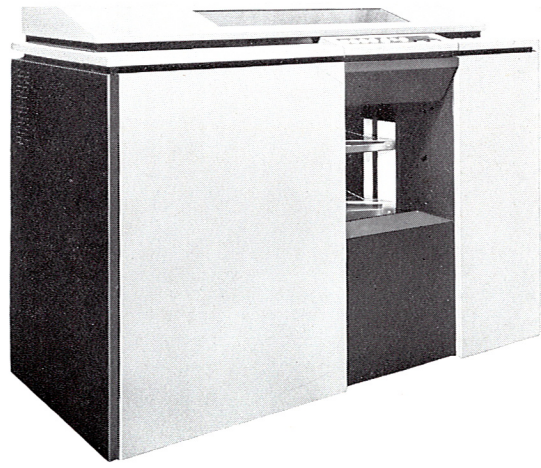
It eliminates need of specially trained skill to feed data into the computer and the layman can feed the data simply by writing them. Therefore, it is a very effective input unit for systems having a wide range of data sources.

FEATURES OF THE N240P-1 OPTICAL MARK READER

1. The read-out speed is as fast as 200～250 cards/minute and a very large amout of data can be processed.
2. Data written on cards of B_4, A_4 and B_5 (cards having sides between these cards included), which are most widely used, can be read.
3. If there are two marks within the same numeral, the N240P-1 reads the darker mark through its gradation comparison circuit and detects mis-writing and mis-reading.

Specifications of the N240P-1 Optical Mark Reader

Read speed	200～250 cards/min.
No. of read marks	26 pieces×96 pieces (max.)
Card size	7.2×100～10.0×14.3 inch.
Hopper	1,000 cards×1
Stacker	Accepts 500 cards×2 Rejects 200 cards×2



N220P-1 Optical Mark Reader

OPTICAL JOURNAL READER (N235)

The Type N235 Optical Journal Reader Control allows a National Cash Register (NCR) Model 420 Optical Journal Reader to operate on-line with any NEAC-Series 2200 central processor. The Model 420 optically reads printed journal tapes from a variety of input machines (e.g., cash registers, accounting machines, adding machines). The NCR font character set, consisting of 16 stylized numbers and symbols, is used.

The control performs no translation, but, instead, character equivalents have been established between the NCR font character set and the NEAC code configuration. Under control of the central processor program, the N235 control transfers data from the reader memory to main memory at a rate of 83,333 characters per second. Standard NEAC-Series 2200 interrupt capabilities are included in the control unit. The Model 420-1 Optical Journal Reader has a maximum speed of 26 lines per second, and the Model 420-2 has a maximum speed of 52 lines per second. Depending on the operating mode selected, unreadable lines will cause the reader either to halt after a predetermined number of backups and rereads or to mark the error line on the reverse side of the journal tape and continue the reading sequence.

Journal Tape Reader Control (N235)

Model	NCR420-1	NCR420-2
Control Model No.	N235	
Processing speed (lines/sec.)	26	52
Type of character	NOF font characters, 16 types	

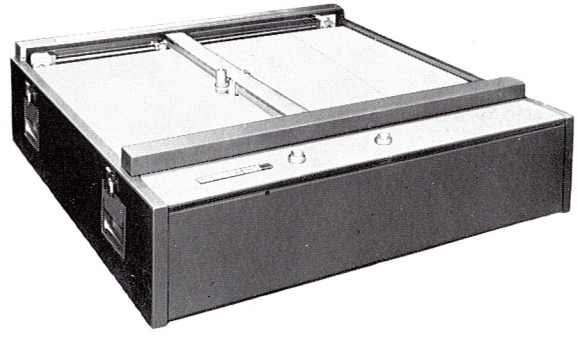
DIGITAL PLOTTER (N244A-1, N244A-2)

The Type N244A-1 and N244A-2 Digital plotters are output units used in the NEAC-Series 2200 computer systems, and record data from the computers directly without manual help in the form of diagrams or graphs.

Each of them consists of a plotter control and a plotter unit. The plotter control is connected with a desired output trunk of the central processor, decodes instructions from the central processor, and controls the operation of the plotter unit. The plotter unit, through the plotter control, creates very accurate ink-on-paper plots, producing curves and symbols of any desired shape. They operate digitally, moving the pen in discrete increments in any of eight directions with the pen either raised or lowered. They are used to advantage in situations where graphical or pictorial representation of computer data is easier to interpret and use than extensive numeric or alphabetic listings.

The maximum plotting speed is 300 increments per second, in any of eight directions. The plotter control employs the standard interrupt capability of the NEAC-Series 2200 processors.

Model	N244A-1	N244A-2
Recording area	0.98 in. ×1.5 in.	2.5 in. ×2.7 in.
Recording speed	300 steps/sec.	200 steps/sec.
Pen speed (up and down)	10 times/sec.	10 times/sec.
Step distance	0.008 in.	0.008 in.
Paper feed speed	about 0.2 in./sec	—



N244A-1, 2 Digital Plotter

INPUT/OUTPUT TYPEWRITER (N220A)

The Type N220A is an on-line input/output typewriter used in a NEAC-Series 2200 computer, and can be used as one of peripheral equipment or off-line equipment.

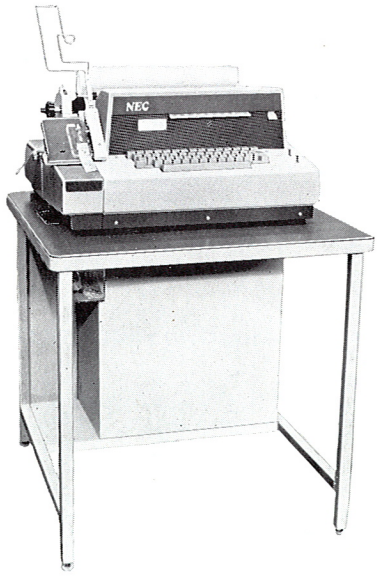
When used as peripheral equipment, it can type out messages from the cetral processor, can put in and out paper tape data and can put out data from the main memory to the paper tape under the program control.

In an off-line mode, it can be used as a data punch typewriter. Namely, it can print and punch data by means of keys, can print and punch data through reading-out of the reader, and can punch data through reading-out of the reader.

The N211A multi-typewriter control unit controls the transfer of data between the input/output typewriter and the central processor of a NEAC-Series 2200 computer system. It also undertakes various checks involved in data transfer, and can connect a maximum of the N220A I/O typewriters.

	N220A E220*
Printing speed	560 cpm.
Read-out speed	560 cpm.
Punch speed	900 cpm.
Keyboard	48 keys, 2-stage shift Numerical .....10 Alphabet .....48 Special symbol ...12 Kana letter .....48 } 96
Code	(a) 6-channel NEAC code (b) 8-channel BCD code (c) 8-digit NEAC code

* Available only on the Model 50.



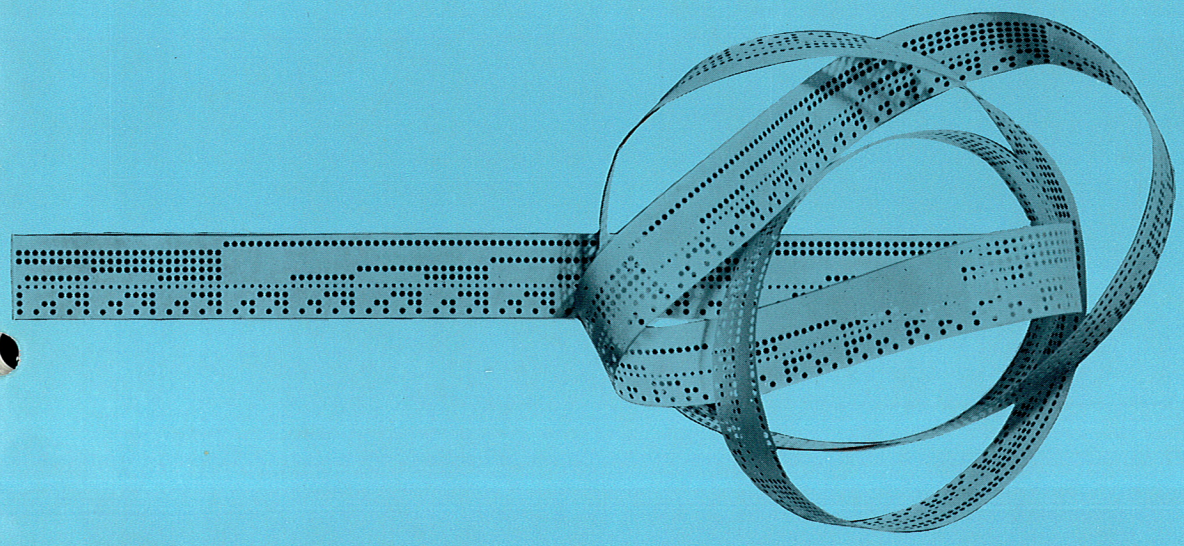
N220A Input/Output Typewriter

Data Communications Facilities

NEC provides a broad-scale data communications capability, the highlights of which are:

- Communication control unit to handle an exceptionally wide array of communications lines' speeds and terminal devices.
- Fast-access mass storage devices.
- Powerful processor communications features, including an automatic interrupt system, multilevel code handling capability, an interval timer and a programmable real time clock.
- An advanced, multipurpose remote terminal device, the data station.
- A full line of software for interrupt processing and message handling.

Of particular importance is the fact that this entire communications capability is available for use in any NEAC-Series 2200 system, regardless of the processor model chosen by the user.



PROCESSOR COMMUNICATIONS FEATURES

Several features available in NEAC-Series 2200 processors make them especially well suited to handle communications applications. The simultaneity, automatic hardware interrupt facility and high internal speeds of these central units provide a very significant capability-effective processing of communications and conventional jobs at the same time. Flexibility in application design is provided by the ability to process ISO as well as other 8-bit codes.

SIMULTANEITY

The use of program-assignable read-write channels in NEAC-Series 2200 processors enables them to direct the data flow to and from several peripheral devices and, concurrently, to perform computing operations. For example, the Model 150 processor can perform up to four input/output operations at the same time that internal processing is going on. Projected to the Model 700 processor, this facility allows 24 peripheral data transfers to proceed simultaneously with computing.
This greater throughput is simultaneity's chief contribution to integrated communications/business data processing systems. While other processors might falter under a multiple load such as this, NEC's simultaneity assures high production rates on conventional applications even while handling heavy communication traffic.

INTERNAL SPEED

Concurrent I/O and internal processing must be coupled with internal speeds high enough to allow efficient handling of data received or transmitted to provide an effective computing system. NEAC memory cycle times, ranging from 2 microseconds per character down to only 63 nanoseconds per character, provide internal processing speeds which are suitable complements to the aforementioned simultaneity. These speeds enable complete processing of communications data even when transmission is at high-volume rates. For example, the Model 150 processor, which has a 2-microsecond memory cycle, can efficiently handle single-channel applications at rates up to 167,000 characters per second.

AUTOMATIC INTERRUPT FACILITY

Available for use in all NEAC-Series 2200 processors is a completely automatic program interrupt facility. The advantage of this interrupt is that it enables simple but efficient direction of processing involving concurrent real time and business or scientific applications. The interrupt facility allows automatic branching, as necessary, between a main program and real time service routines. In particular, the readiness of a communications control to receive data for transmission or to relay data coming in from a line can automatically trigger entrance to a stored routine to service the external demand immediately. (Interrupt routines, applicable to most communications environments are provided by NEC as part of the standard software). Automatic signaling of control status obviates the necessity for programmed tests of these units to detect the arrival of data or the readiness to transmit. The interrupt facility also includes automatic storage of main program indicator values and control register contents, as well as an interrupt source indication.

MULTILEVEL CODE-HANDLING FACILITY

All NEAC-Series 2200 processors are equipped with a facility enabling them to bring into memory and manipulate data in many different codes. This feature includes the ability to translate automatically between character codes of up to 12 levels and also to trap special code configurations of up to 12 levels.

TIMING DEVICES

Two types of devices are available for use in NEAC-Series 2200 processors to give programs access to real time information; each requires one input/output trunk. A Model N213-3 interval timer provides automatic program interrupts at program-specified intervals. A Model N213-4 time-of-day clock permits a program to determine the current clock time in hours, minutes, seconds and tenths of seconds. These devices may be used in such applications as: (1) timing of program runs; (2) logging times of remote inquiries and information input; and (3) starting programs at specified intervals or clock times, as in polling a communications network.

DATA COMMUNICATIONS CONTROLS

Multichannel control is available to enable NEAC-Series 2200 systems to receive and transmit data over toll and leased lines. One of the most outstanding features of these devices is the broad selection of lines, speeds and terminal devices to which they can be connected. This selection is one of the largest offered by any manufacturer. The compatible services and equipment are indicated in the accompanying table.

Applicability of NEC Communication Equipment

LINE	MODEMO	Line Speed	Communication /Adapter
DC Line	—	50 bps	N285L-1 N293L-1
Voice Line	DATAX 202M DATAX 203M DATAX 205M DATAX 206M	200 bps	N285A-2 N293A-2
Voice Line	DATAX 1203M DATAX 1205M DATAX 1206M	1200 bps	N285A-3 N293A-3
Voice Line	DATAX 2405M DATAX 2406M	2400 bps	N293A-4
Multiwire	—	20 char./ sec.	N285C-1 N293C-1

CCU (Communication Control Unit)

The N284-2 CCU is designed to control 32 communication circuits while the N284-3 CCU and N292 CCU can control 64 and 256 communication circuits, respectively. They smooth transmission and reception of data over the circuits between the terminal equipment and CPU.

The N285A – L Line Adapters can be additionally provided to the circuits, N284A-2 and -3 CCU's so that low-speed telegraph grade communication lines and medium- and high-speed voice lines of such various transmission methods as asynchronous, synchronous and multiwire systems can be connected.

The N293 Line Adapter can be additionally provided with the circuits and N292 CCU.

Characteristic \ Type	N284A-2	N284A-3	N292
Maximum Number of Lines	32	64	256
Transmission speed	50,200	1200 pbs	50,200, 1200, 2400 bps
Code unit	5, 6, 7 and 8		
Transmission Mode	Half duplex or full duplex		
Synchronization	Start/stop		Start/stop Synchronous
Type of Line	Private line		
Maximum Type of Terminals	Four types per CCU		
Peak Transfer Rate Char./sec.	2000 char./sec.		7000 char./sec.

DATA PROTECTION

The validity of data being communicated is protected by three different means:

- Parity and long checking are used for all NEAC devices as a standard feature.
- A transmission lapse results in the automatic setting of a program-accessible indicator in the receiving processor.
- Confirmation of the message received or re-transmission dispatched is also executed.

COMMUNICATIONS SWITCHING UNITS

By the communication switching unit (Model N215A/B) up to 256 lines may be switched simultaneously to another multi-channel control. The N216, N216A-1 and N216-2 peripheral control switching unit enables a communication control facility to switch between different NEAC-Series 2200 systems: Many combinations of these two facilities may produce many ways of switching.

RANDOM-ACCESS STORAGE

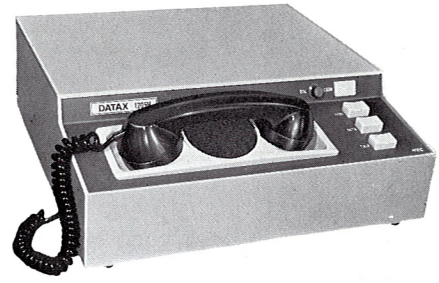
A major requirement of many communication appreciations, such as those involving inquiry and message switching, is fast access to information which has been placed in storage. Of course, core memory provides the fastest access possible. But when dealing with large files, core memory becomes too expensive. To fill this need for economical storage, NEC offers a complete line of magnetic tape units and the random access files described in a preceding section.

The magnetic drum gives access to any record at random in an average time of 8.3 milliseconds.

NEAC magnetic tape units provide sufficiently fast access for the majority of applications, and are by far the most economical devices in terms of storage capacity per price.

MODEM (Modulator and Demodulator)

It has become necessary to transmit various types of data to remote places quickly, accurately and economically. For this purpose, a communications line has to be used both for telephone and data communication.



DATAX 1200 MODEM

NEC DATAX Modem

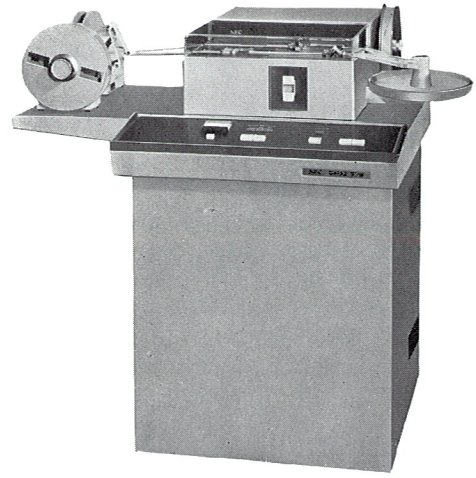
Model	Trans. Speed	Applicable Line	Modulation and Frequency	Signaling System	Application	Remarks
DATAX 203MC, D	200 bps or less	Private-oriented switched network	FM : 1080±100 Hz 1750±100 Hz	Dial	MC : Telephone or telegraph MD : Telephone or Data trans.	CCITT interface
DATAX 205MA, B	〃	2 or 4-wire leased voice band line	〃	Speaker	MA : Telephone or telegraph MB : Telephone or Data trans.	〃
DATAX 206MC, D	〃	4-wire leased voice band line	FM : 1200±100 Hz	〃	MC : Telegraph MD : Data trans.	〃
DATAX 1203MA	1200 bps or less	Private-oriented switched network	FM : 1700±400 Hz	Dial	Telephone or data trans.	〃
DATAX 1205MA	〃	2 or 4-wire leased voice band line	〃	Speaker	〃	〃
DATAX 1206	〃	4-wire leased voice band line	〃	—	Data trans.	〃
DATAX 2404MA	2400 bps	4-wire leased voice band line	FhM : 1800 Hz	Speaker	Telephone or data trans.	〃
DATAX 2406MA	〃	〃	〃	—	Data trans.	〃

NEC's MODEM was designed to meet such a requirement, and affords transmission of data to various destinations. It can be connected with existing automatic exchange telephone lines and can be used both for telephone and data communications by means of a dial. Through the NEC MODEM, data communication can be achieved even if the receiving party is not present.
The DATAX 200, DATAX 600, DATAX 1200 and DATAX 2400 are available for selection depending upon transmission speed desired.

PAPER TAPE TERMINAL

The N6010 Paper Tape Terminal features high quality and high performance. It can send and receive paper-taped data at a speed of 50 bits/sec. and 200 bits/sec.

Model	N6011	N6012
Transmission speed	50 bits/sec.	200 bits/sec.
Transmission system	Duplex transmission	
Sync. system	Start-stop synchronization	
Code used	Six units (domestic), eight units (international)	

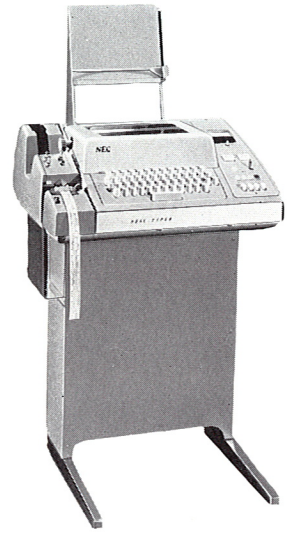


N6010 Paper Tape Terminal

NEAC TYPER

The N6020 NEAC Typer is available in two models—N6021 and N6022—which are used as compact on-line terminals. The NEAC Typer is linked with a computer over a communications line to transmit and receive information at a speed rate of 50 bits/sec.

Model	Paper Tape Units	Composition
N6021 ASR (For automatic transmission and receiving)	6	Keyboard Printer Paper tape reader Paper tape punch
N6021 KSR (For transmission and receiving)	6	Keyboard Printer
N6021 RO (For receiving only)	6	Printer
N6022 ASR (For automatic transmission and receiving)	8	Keyboard Printer Paper tape reader Paper tape punch
N6022 KSR (For transmission and receiving)	8	Keyboard Printer
N6022 RO (For receiving only)	8	Printer

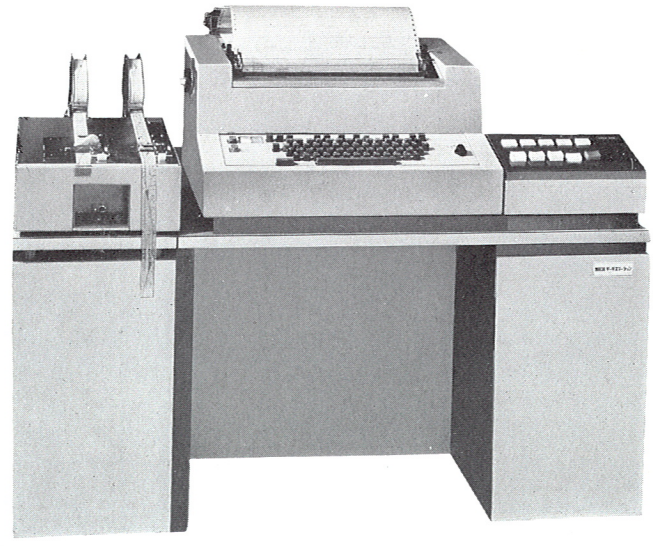


N6020 NEAC Typer

DATA STATION

The N6030 and N6040 Data Stations are general purpose terminals which can be used for various types of data communication, and can be provided with a wide range of input and output units to meet various types of business.

	Model	Performance
N6030 Data Station	N6031A/B Transmission Control	200 – 1200 bits/sec.
	N6032 Keyboard Printer	1200 letters/min.
	N6033A/B Printer	1200 letters/min.
	N6034 Paper Tape Printer	1200 letters/min.
	N6035M Mark Sheet Reader	60 columns/sec.
	N6035S Stacked Mark Sheet Reader	20 sheets/min.
	N6036 Card Reader	100 cards/min.
	N6037 Key-set	12 lines × 16 col. (192 buttons)
	Model	**Performance**
N6040 Data Station	N6041 Transmission Control	1200 bits/sec.
	N6042 Typewriter	560 letters/min.
	N6043 Paper Tape Printer	300 letters/sec.
	N6044 Paper Tape Punch	110 letters/sec.
	N6045 Card Reader	100 cards/min.
	N6046A/B Card Punch	9 columns/sec.
	N6047 Line Printer	200 lines/min.



N6030 Data Station

KEY-SET TERMINAL

This terminal is designed that it can be easily used like a typewriter, and is suited for such operations as seats reservation and stock/sales control. The Key-set Terminal is very economical.

	Model	N6050
	Transmission speed	200 bits/sec.
	Transmission system	Semi-duplex
Key-set Unit	Data input button	12 lines × 16 col. (192 buttons)
	No. of key mat books	63, max.
	No. of pages per book	5 pages, max.
Printer	Printing speed	1200 letters/min.
	No. of letters printed	128 letters (English letters, codes, and Japanese "kana" letters and "kana" codes)

N6050 Key-Set Terminal

MARK SENSE TERMINAL

The Mark Sense Terminal is a compact assembly of a mark reader and a printer. It is very economical and is suited for the open shop inquiries.

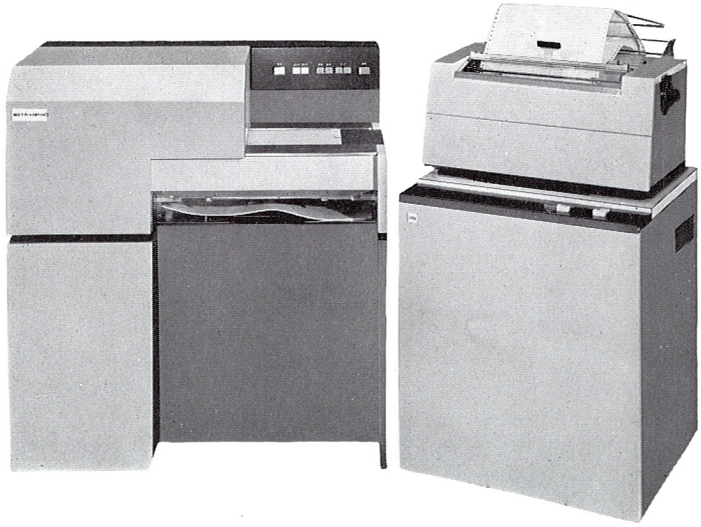
	Model	N6060
	Transmission speed	200 bits/sec.
	Transmission system	Semi-duplex
Mark Reader	Max. No. of mark accommodated	About 1510 marks
	Reading speed	10 columns/sec.
Printer	Printing speed	1200 letters/min.
	No. of letters printed	128 letters (English letters and codes, Japanese "kana" letters and "kana" codes.)

N6060 Mark Sense Terminal

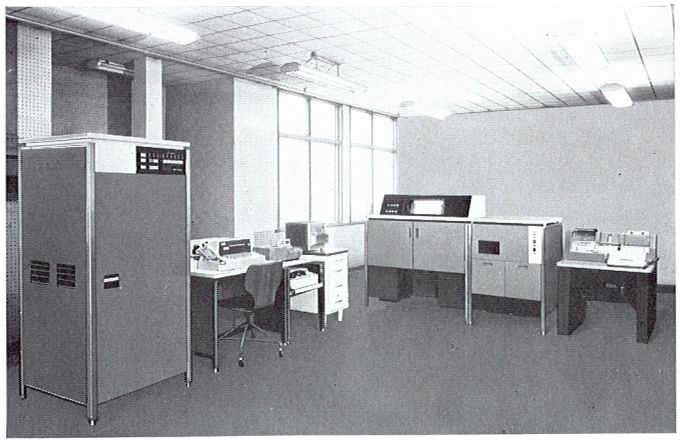
MARK SHEET MULTIPLEX TERMINAL

The N6070 Mark Sheet Multiplex Terminal consists of several mark sheet readers and printers, and is suited for various window services including registration.

	Model	Performance
N6070 Mark Sheet Multiplex Terminal	N6071 Transmission Control	1200 bits/sec.
	N6072 Typewriter	1200 letters/min.
	N6073 Mark Sheet Reader	60 columns/sec.
	N6074 Printer	1200 letters/min.



N6070 Mark Sheet Multiplex Terminal



N6040 Data Station

DATA SCOPE

N287A-31 and N287A-32 NEAC data scopes provide the facility for immediate access and display of stored data. They also introduce the capability to function off-line for message creation, verification, and correction by an operator, then on-line for message entry to and retrieval from the computer. The integration of computer and display provides a processing/communication system with the flexibility of localized query and update of data files, while maintaining centralized information control.

N287A-31 (for business use) and N287A-32 (for industrial use) are available, providing a wide range of display capabilities and keyboard arrangements for functional adaptability to any application.

The number of data scopes used may be from one to up to 24, although each data scope operates independently of the others. The information cycle from query to displayed response is completed in seconds, whether the display-to-computer connection is a few hundred meters or, via communication lines, several thousand kilometers long. Data stations connected in any one area utilize an N286 data scope control unit as a local storage medium, control and communication link.

Additional expansion, control and communication modules can be connected to the local control to provide more buffer storage, editing function and communication capabilities.

The N286 data scope control can be remotely or directly connected to a communication control unit.

With either remote or direct connection, communication modules are available to provide asynchronous transmission of ISO-coded data at rates of 1200 baud over standard half-duplex communication lines.

N287A Data Scope Specifications

Keyboard	Numerical .....10 Alphabetic .....26 Special symbol .....23 Kana letter .....48 Control symbol 2
Viewing Area	12-inch (for business use) 19-inch (for industrial use)
Display Capacity	32 ch×16 row : Up to 512 characters 64 ch×16 row : Up to 1024 characters

N287 Data Scope

BANKING EQUIPMENT

Powerful computers and versatile input/output devices, plus a wealth of experience in the solution of many and varied banking problems, eminently qualify NEC to serve all types and sizes of banks.

NEAC DEPO

The NEAC DEPO expresses the banking terminal equipment connected directly with an NEAC-Series 2200 computer system. The NEAC DEPO system to be installed at branch offices has three principal features.

First, a DEPO control unit can have four NEAC DEPO's linked and a NEAC DEPO can handle ordinary deposit, current deposit and deposit at call. In addition, the NEAC DEPO can be easily backed up by other DEPO even in the case of a failure, and does not need an emergency installation.

Second, if an off-line function is additionally provided, the NEAC DEPO can continue operation without any interruption despite a failure in the computer center or in the circuit. Various countermeasures are provided against errors in the transmission circuit, such as horizontal and vertical parity checks, periodical monitoring and checking from beginning to end, etc. In addition, the circuit of 200 or 1200 bps can be configured depending upon the amount of work and volume of data. Third, being completely solid-state, added reliability is ensured and use of a micro-programming method affords easy addition or change of functions.

The NEAC DEPO is provided with five functional parts. They are the key set, a display set, inspector key, a printer and operator keys.

The key set consists of a data key, a function key and operator keys.

The display set comprises mode lamps, which indicate the operating condition of the on-line banking terminal equipment, and function lamps which indicate the state of processing, to ensure reliable system operation and accurate processing.

The inspector key is normally kept locked.

The printer can perform journal printing, pass-book printing and certification note printing separately or simultaneously.

The operator keys are provided to specify the operators so that many operators can use the NEAC DEPO.

NEAC DEPO

Software

NEAC-Series 2200 hardware reflects the most advanced know-how in the computer industry. To consummate the effectiveness of the system, NEC has developed a comprehensive array of programming, conversion and operating aids (or software) that will ensure each user's realization of the hardware's great potential. All software is supplied in versions tailored to fit equipment configurations comprising many different memory capacities and input/output combinations.

The NEAC-Series 2200 hardware consists of nine models of central processors; Models 50, 100, 150, 200, 250, 300, 400, 500 and 700. As represented by the "ONE-MACHINE CONCEPT", sufficient interchangeability has been given between each model of these computers. Consequently, the NEAC-Series 2200 software system is operationally compatible with each other and with the object programs that they produce. Object programs produced by a variety of program preparation aids, as well as programs from the software library, may all be intermixed on run tapes and processed together.

The NEAC software system is broadly classified into the following two systems:

A) NEAC-Series 2200 Programming System
B) NEAC-Series 2200 Application System

The outlines of these systems are described below.

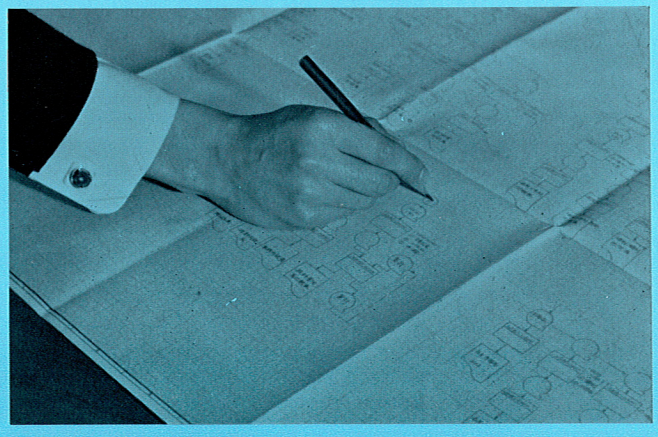
The Programs Library comprises three distinct classes of software:

Programming and Operating Systems (class I)—Software which performs computer management functions such as language processing, program checkout and maintenance, operations control, I/O control, data editing and transcription, and mathematical processing. These systems are described later in this section.

Application Systems (class II)—Special-purpose software which performs jobs closely related to the functions of the user's organization (e.g., inventory control and sales forecasting). These systems are described later in this section. User-Submitted Routines (class III)—Voluntarily contributed routines by users and NEC employees to aid the programming and systems community. These programs have been specialized for execution by their contributors and may require modification for use by others.

Class I programs, commonly referred to as systems software, are grouped into Programming Systems and Operating Systems. Programming Systems are specifically oriented to small configurations. They provide basic functional support capabilities with emphasis on simplicity and ease of use. Operating Systems offer more sophisticated capabilities required for effective utilization of medium- and large-scale configurations. They provide comprehensive functional support in the preparation and execution of user programs and are aimed at optimizing the throughput performance and response of the hardware. In contrast to Programming Systems, Operating Systems require that a substantial amount of core memory be dedicated to resident control routines.

Programs of class I are conceived and developed by NEC to achieve most efficient utilization of system processing capabilities. Facilities provided by these programs include program preparation and maintenance, data control, operations control, and utilities—all designed to provide optimum flexibility for the user.



PROGRAMMING SYSTEM

The NEAC-Series 2200 Programming System is composed of :
I) Easy Programming System
II) Operating System
The operating system is divided into the following seven levels :
1. Operating System MOD I MSR
2. Operating System MOD I TR
3. Operating System MOD I EXTENDED
4. Operating System MOD III
5. Operating System MOD IV
6. Operating System MOD IV EXTENDED
7. Operating System MOD VII

III) Time Sharing System
The above classification has been made according to memory capacity required by each system.
The figures shown in the right hand column of the following table indicate the required memory capacity.

EASY Programming System		88 KC
Operating System	MOD I MSR	12 KC
	MOD I TR	12 KC
	MOD I EXTENDED	49 KC
	MOD III	96 KC
	MOD IV	131 KC
	MOD IV EXTENDED	262 KC
	MOD VII	262 KC

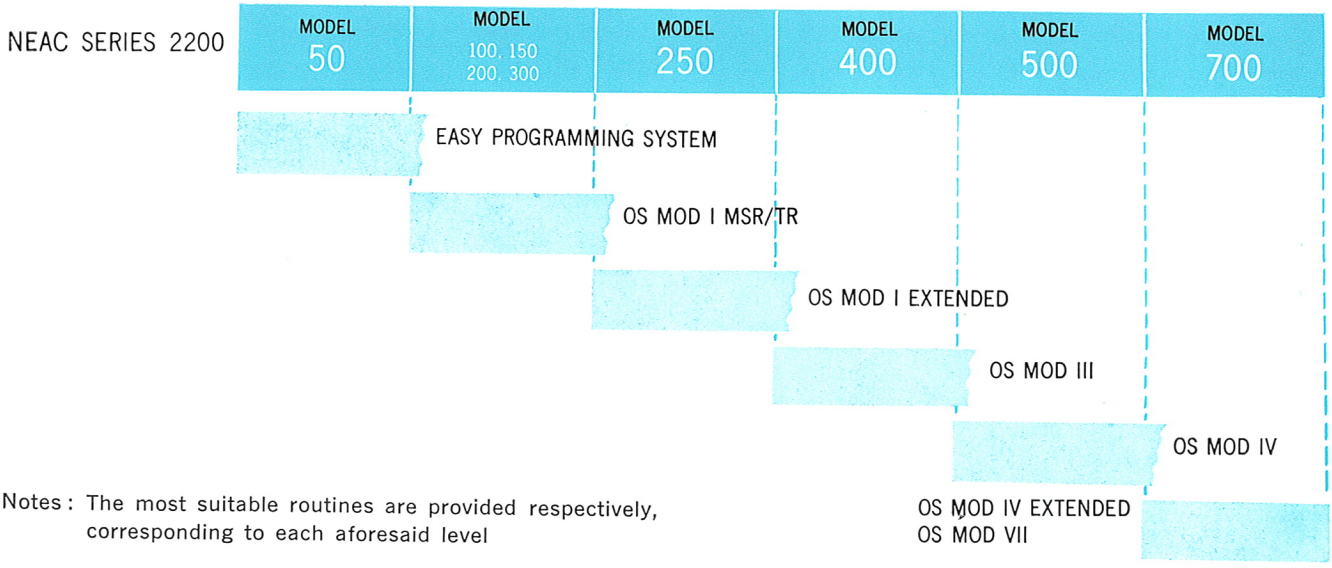
This is not an accurate classification. For example, some of the Operating System MOD I routine can also be used even in a system having a memory of less than 12 KC. Accordingly, the memory capacity used as a basis for classifying each level does not mean the essential condition, but shows the minimum memory capacity needed to operate each system most efficiently.

SYSTEM DESCRIPTIONS

The EASY Programming System and the Operating System models and Time Sharing System are summarized in the following pages. Within the EASY Programming System, the MOD I (MSR)Operating System, the MOD I (Extended) Operating System, and the MOD III Operating System, some components illustrate distinctive facets of NEC software and therefore described at some length.
The degree of integration in the MOD I (TR) Operating System, MOD IV Operating System, MOD IV (Extended) Operating System, and the MOD VII Operating System precludes the singling out of specific components for expanded discussions. The comprehensiveness of these systems, however, does not mean that they lack the modularity that is basic to the design of all NEC software. A user can make a transition to these systems as his needs demand. Remember that each operating system model offers unique capabilities which reflect the needs of user's at various levels of system development. It is the individual user's path of development that determines his choice of operating system components.
The software system of the NEAC-Series 2200 computers is classified into seven operating levels, and is used as illustrated.

EASY PROGRAMMING SYSTEM

The Easy Programming System was completed for the NEAC-Series 2200 Model 50, a small-scale business oriented computer, which is used for sales control, sales/stock control and batch processing in medium- and small-scale enterprises.
It was designed based on the "3-E System" conception—that is, "EASY", "ECONOMICAL" and "EFFECTIVE" operation.
With the aid of the Model 50's effective programming systems, the user can operate this computer with the same ease as with a tabulating equipment. Likewise, the Model 50 possesses various application system packages providing efficient, high-degree electronic data processing of retailing and other functions as soon as the system is installed.



Notes : The most suitable routines are provided respectively, corresponding to each aforesaid level

The central programs of the Model 50's 3E system software are "EASY BILL", "EASY PRO" and "EASY COBOL".
In these systems, a flow-oriented idea (the flow of business operation is applied as it is to the computer) is incorporated to reduce the programming processes.
From a standpoint of "EASY", "ECONOMICAL" and "EFFECTIVE", the basic designing ideas of the NEAC-Series 2200 Model 50, the Easy Programming System features:

EASY

(1) As various kinds of programs can be used by merely setting simple parameters, the operator does not require programming skill and no specialist operator is needed.
(2) Use of standardized application packages saves labor for job analysis.

ECONOMICAL

All standard systems are designed on the basis of a 4 K to 8 K memory and paper tape (both 6-unit (NEAC code) and 8-unit (BCD code) can be used) for economical application. They are flexibly designed, and can increase numbers of memory and can easily expand their capacity.

EFFECTIVE

Bills of the same and different kinds, which come from several typewriters, can be simulteneously processed. Namaly, programs are separately and simultaneously controlled.
In addition, more powerful programming systems, including language translators and other operations, are provided to meet the user's specific requirements.

EASY PRO

The batch process in data processing is divided into several functional patterns such as sorting, collating, merging and reproducing which are functions of the tab equipment (i.e., sorters, collators, printers, etc.). These tabulating functions are performed by the EASY PRO system which retains the tab procedures but substitutes the speed and processing capabilities of the Model 50 computer for the slower, less efficient operation of the tab equipment. The use of EASY PRO is believed to be the soundest approach available to organizations that have outgrown tabulating equipment and are planning to use computers for the first time. The EASY PRO system currently includes such programs as SORT, MERGE, SELECT, REPRODUCE, PERIO (peripheral Input/Output), ALTER, UPDATE and REPORT. To use an EASY PRO program, the programmer prepares one or more parameter cards to request the appropriate options. He inserts these cards in the input deck and then runs the program.

EASY BILL

EASY BILL is a highly automated billing system performing all functions of the billing process. With EASY BILL, the Model 50 performs operations according to the desired bill format, such as keying the desired item code in the specified field, referring to the file for desired item codes and typing them out, and producing the output list. Items stored on master files of magnetic disk packs or drums can be updated at the issuance of bills to produce journal tape for further requirements.
To use EASY BILL, the programmer prepares only two parameter forms; i.e., the file define form and procedure form. On the file define form, the programmer defines the item configurations on the file. On the procedure form, the programmer describes what should be printed on what part of the bill, and what kind of calculations should be performed He inserts these parameters in the computer and then runs the program.
This reduces training of the programming staff to a minimum, saving money and time.

EASY COBOL

In addition to the COBOL compiler available for the NEAC-Series 2200 with the memory size of 8192 characters, NEC has developed EASY COBOL or COBOL for the Model 50. The programmer describes his statements in COBOL which provides a relatively machine-independent method of expressing a business-oriented problem in the Model 50 computer. The EASY COBOL compiler is designed to be modularly expandable and is self-adapting to memories larger than the minimum.
During the execution of EASY COBOL programs, the memory occupation rates and execution times are almost the same as those of assembly programs. Also, the costly, time-consuming and program testing is more simplified and requires far less time with EASY COBOL than with assemblers.

OPERATING SYSTEM

OUTLINE OF OPERATING SYSTEM, MOD I

The Operating System MOD I is a software system which was prepared to improve the overall performance of medium-scale NEAC-Series 2200 computers.
Although the MOD I can be used for all NEAC-Series 2200 models, it is mainly used for Models 150, 200 and 250. It is designed on the basis of a magnetic tape or mass storage (disk pack or disk), and features simplicity, efficiency and flexibility.
The MOD I can be classified into tape resident, mass storage resident and extended tapes.
The Operating System MOD I MSR (mass storage resident) is used for the Models 150, 200 and 250 consisting of magnetic disk units as their key installation while the MOD I TR (tape resident) is used for Models 100, 150, 200 and 250 consisting of magnetic tape units as their key setup.
The programs and data for these two operating systems are compatible and the two systems can be used in combination depending upon their application.
The Operating System MOD I Extended incorporates the functions of the MOD I MSR and MOD I TR in addition to its functions so as to fully utilize such capabilities of the Model 250 as the on-line real-time and multiprogram processing.
The Operating System MOD I Extended is completely compatible with the MOD I MSR and MOD I TR, and the computer system using it can be easily expanded.

OPERATING SYSTEM MOD I TR

The Operating System MOD I TR was designed to operate the Models 100, 150 and 200 consisting of magnetic tape units as their key setup more effectively. It is also designed to eliminate uneconomical overhead cost as in the case of the MOD I MSR. The outline of the MOD I TR is as follows:

• Job Control
As with the supervisor of the MOD I MSR, several loader monitors provided with such functions as listed below are available for selection :
• Continuous job execution
• Program loading
• Control of multiple program
One monitor is used for programs recorded on magnetic tapes, the second loads the programs recorded in the magnetic drums to the main memory, and the third is used for the paper tape based systems.
• Data Control
Input/output control routines are abundantly available to control the input and output operations of various peripheral units. These input/output control routines, which are needed for programs, are stored in the main memory so that the main memory is not occupied by the input/output control routines of the peripheral units are not needed for the program execution.
The main input/output control routines available are:
• Several different routines for the magnetic tape unit
• Input/output control routine for the magnetic drum unit
• Input/output control routine for the paper tape input/output units
• Input/output control routine for card read/punch unit
• Control routine for the high-speed line printer
• Control routine for the communication control unit
As explained previously, as the MOD I MSR and MOD I TR can be used in combination, the input/output control routines available for the MSR system are used for the magnetic disk unit.
• Program Preparation and Control

Language Processing Program
Easycoder assembler, COBOL compiler, Fortran compiler and Algol compiler are available.

Program Filing
Programs which were recorded on the magnetic tape and drum units, (programs translated by the language processing program), file renewing programs and programs which will merge the symbolic programs files are available.

Program Testing
In addition to the routine which dumps specified part of the main memory and magnetic tape, there are such programs as one for program correction by the machine language, one which traces the other programs and one which analyzes the programs written in assembler language so that programs can be easily debugged.

Utility Routines
• Sort Program
In addition to the program which is used to sort the data stored in the magnetic tape or drum unit, the following utility routines are provided :
• Program which converts the data among various types of input/output units.
• Program which copies and debugs data stored in the magnetic tape unit.
• Program which copies and debugs data in the magnetic drum unit.

OPERATING SYSTEM MOD I MSR
The MOD I MSR is an operating system which was designed to operate Models 150, 200 and 250 consisting of magnetic disk unit (N273B Disk Pack Unit, N259 Disk Pack Unit, etc.) as their key setup more effectively.
To operate the system more effectively, the programming is performed by the system source (main memory, peripheral unit, etc.) required for the programming so that there is no uneconomical overhead time. Namely, in the case of a programming in which no magnetic tape unit is needed, the main memory is not occupied by the routine needed for the input/output operation of the magnetic tape unit.
The MOD I MSR can be roughly classified into the following four sub-systems :
• Job control • Data control
• Program preparation and maintenance • Utilities

Job Control Routine
All jobs executed by the MOD I MSR are controlled by the supervisor as follows:
Job control
As soon as a job terminates, it automatically controls a new job.
Multiprogram processing control
It simultaneously processes the foreground and background programs.
Program loading
It loads specified programs into the main memory from the program files recorded in the magnetic disk unit.
When the main memory capacity is small or when the foreground program is not frequently used, a program which is called the "roll-in roll-out monitor" is available.

Data Control Function
The Data Control Function can be divided into two functions —input/output controlling and file supporting.
The input/output routine, which controls the input/output operations, consists of several macro-routines and the programmer, by specifying the function needed for his job by means of a parameter, can read or write the data stored in in the magnetic disk.
The following four magnetic disk files are available for selection:
• Sequential file • Partitioned sequential file
• Indexed sequential file • Direct access file
The file support consists of several routines having the following functions:
Allocate
It allocates filing areas in the magnetic disk unit.
De-allocate
It deletes the areas in the magnetic disk unit which are allocated for files.
Load/unload
It transfers data between the magnetic disk unit and other peripheral units.
If an output file is a magnetic disk unit, it is called the "Load" and if an input file is a magnetic disk unit it is called the "Unload".
Map
The following three lists can be mapped out:
• Information of files allocated in the magnetic disk—such as the name and type of the files, and area allocated for the files.
• List of files, preservation period of which is over.
• List of unused areas in the magnetic disk.

Program Preparation and Maintenance
• Language Processing Programs
As language processing programs, Easycoder assembly,

COBOL compiler and FORTRAN compiler are available.

• Program file maintenance

A routine, which renews macro-routines or library files recording symbolic programs, and a routine, which renews executable program files recording programs translated into the machine language for possible execution, are available.

The library file and executable program file are normally recorded on the magnetic disk.

• Program Testing

Such functions, which dump the specified area of the main memory or data recorded on the magnetic disk and which correct (normally called the patching) the programs by machine language, are provided.

Utility Programs

As explained previously, the Operating System MOD I MSR and TR can be used in combination. Accordingly, since the utility programs for the magnetic tape are introduced in the paragraph "Operation System MOD I TR", the utility programs for the magnetic disk are explained here.

• Sort Program

This program sorts the data recorded in the magnetic disk.

• Editing Program

This program edits and dumps the specified area in the magnetic disk.

Also provided are the program which copies the specified area in the magnetic disk to the other magnetic disk or magnetic tape (Disk Copy), program which writes up the bootstrap routine in the magnetic disk (Bootstrap Generator) and program which prepares volume level writing and defect truck checking for the magnetic disk unit (Volume Preparation).

OPERATING SYSTEM MOD I EXTENDED

The Operating System MOD I Extended incorporates all functions provided with the Operating System MOD I MSR and MOD I TR, and is provided with such additional functions as multiprogram processing and on-line real-time processing so as to fully utilize medium- or large-scale Model 250. Namely, by effectively utilizing its precise storage protective and interruption functions, the Operating System MOD I Extended can execute the foreground processing and background processing in parallel.

As the foreground processing, on-line processing by means of communication line (inquiries, message exchanging, data collection) or data exchange processing are normally executed. On the other hand, in the background processing, program translation, data sort and business and scientific calculations prepared by users are executed.

• Multiprogram

The Operating System MOD I Extended divides its main memory into a foreground program, a background program and a monitor program to execute multiprogram processing. Each area is divided into the upper and lower parts by the monitor program by utilizing two registers, each having a storage protective function, so as to prevent the main memory's content from being ruined by the programs executed in other areas.

In the monitor area, a monitor program is always present to control the overall system.

The foreground and background areas store the foreground and background programs, respectively, for execution. The foreground program processing always takes precedence over the background program processing which is executed while the input/output operation of the foreground program is suspended (I/O busy).

• Foreground Program

As the foreground program, on-line real-time processing and data conversion program are executed. When performing the on-line real-time processing, three message programs can be simultaneously processed. The input and output message queuing is automatically achieved by the control program.

For easy message processing programming to be executed in the foreground area, several macro-instructions are provided.

Three data conversion programs can be executed simultaneously also when the data conversion is to be performed by the foreground program.

• Background Program

As the background program, translation and data sorting are performed through the language processing program—such as assembler and COBOL/FORTRAN compiler. Business and scientific calculations are also executed as the background program. In this area, the program used for the Operation System MOD I MSR and TR can be executed without any modification.

In such a case, in the program prepared for the MOD I MSR and TR, instructions—such as "Halt" instruction, which halts the central processor, the PCB/PDT instruction, which performs input/output operation, and instruction which changes the control memory data, all of which are called the privileged instructions—which interfere with the multiprogram processing, are sometimes used. These instructions, however, are automatically handled by the monitor program.

Namely, when these instructions are detected when an independent program (a program which works under the control of the monitor program) is executed, they are not executed to interrupt the program processing and the monitor program is placed under control.

Then, the monitor program investigates the cause of the interruption, and takes the necessary step. If the interruption is due to the "Halt" instruction which terminates the program execution, the operator knows it through the monitor program and prepares for the next program.

Also, the monitor program, by utilizing the functions of the hardware, relocates independent programs. The programs prepared for the MOD I MSR and MOD I TR are normally stored from those having lower address codes but the background area of the MOD I Extended is located at as much upper address code as the foreground area. As a consequence, the address must be corrected but the monitor program, by utilizing the functions of the hardware, automatically corrects it.

Accordingly, the programs used for the MOD I MSR and MOD I TR can be executed, without any change, under the control of the multiprogramming function.

OPERATING SYSTEM MOD III

The MOD III is an operation system prepared for such large-scale computer systems as Models 400 and 500, and is used for batch processing. It can simultaneously process two independent jobs or one job and three data transcription programs.

The Operating System MOD III was developed with the following aims:

- Improvement of overall processing capability
- Shortening of turn-around-time.
- Effective utilization of various system resources.
- Ease of expansion.

In order to achieve these aims, the following methods are

employed:
To eliminate wasted time resulting from the difference of the speed between the central processor and input/output unit, a multiprogramming system is employed so as to make best use of the system resources. In addition, the MOD III can select two multiprogramming systems in execution time—a system in which two stacked jobs are simultaneously processed and a system in which one stacked job and three non-stacked jobs are simultaneously processed. Since the overall processing capability cannot be improved only by improving the use rate of the computer, due consideration is paid to the source language and debugging function. To shorten the turn-around time—the time required until processing is completed starting from when an inquiry is made—the stacked job processing system is employed. Namely, in the normal batch job processing system, one processing function—such as source program interpretation compile—is applied to all jobs. For example, compiling is continuously applied to all jobs and the compiling and its program (object program) are executed at different times.
In order to make best use of the system resources, several new methods are employed. One is the multiprogramming system in which the central processor is most effectively used. The programs which control allocation and management of various input-output units and core memories are uniformly prepared so that they can be effectively used.
To improve the productivity by the programmers, the MOD III is designed so that the programmers can easily use them. Accordingly, the MOD III introduced an idea of program modulation in it to reduce the programmers' labor. Namely, the outputs of the all-language processors (COBOL and FORTRAN compilers and assemblers) consist of small units called the relocatable subprograms and a program is prepared by linking separately interpretated and relocatable programs (the system program which links the relocatable programs is called the linkage loader). In this manner, a program can be prepared in a small unit. Also, an effective debugging function is provided.
The MOD III modulates the functions of the control program as much as possible so that the functions can be easily changed. It also shortens the time required for the system generation so that modules required for the expansion of the operating system functions can be easily added. (System generation is performed by each user to prepare the best suitable operating system. Namely, the user selects and specifies modules needed for the operating system from a number of modules.)

Job Flow

The Operating System MOD III can process two separate stacked jobs simultaneously. The outline of the operation is:
• Job Read-in
In the stacked job processing, data and control cards are normally read in from the card reader but when processing two jobs simultaneously (called the lower job and upper job) two card readers are used. Or magnetic tape (1) will take the place of the card reader(s).
In addition to these methods, in the MOD III, a card reader reads in the job and stacks it on the disk. This is performed by the input reader and it is one of the transitional monitor's functions.
The lower job and upper job arranged on a card reader in desired order are read in by the input reader which in turn classifies them into a lower input and an upper input and stores them in their respective disk area.
• Job Execution
To execute two jobs simultaneously, the main memory is divided into two—the lower area and upper area. This separation is not always definite but it is determined dynamically at the time of job execution. For the programs to be executed in the lower area, the main memory is assigned from the lower address and, for the programs to be executed in the upper area, the main memory is assigned from the upper address.
The first address of each area is set to the base relocation register and the program is executed while being relocated. The first of each area is automatically used as an index register.
• Job Output
The output writer is responsible for the output as the input reader is for the input. Namely, when there are one high-speed line printer and a card punch, either of them can be replaced by a magnetic tape unit when they are required to process the two jobs simultaneously. But, by stacking the jobs on the disk, printing and punching can be performed when the printer and punch are not busy.

OPERATING SYSTEM MOD IV

The Operating System MOD IV was designed to expand the batch processing capability of the MOD III, and is provided with a real-time processing capability. It is specially suitable for such large-scale computer system requiring data communication as the time-sharing system and on-line real-time system.

Processing System

The operating system MOD IV can simultaneously process a total of 20 tasks of non-real-time and real-time jobs. These jobs, in addition to the normal stacked jobs to be demanded by input reader, can include jobs sent from remotely located terminal units. These jobs are all processed by the control program centrally.

Features of MOD IV

• Priority Job Scheduling
Four degrees of priority can be given to the jobs and the control program is provided with a function to process the jobs in accordance with their priority.
• Catalogue Procedure Function
The operating system needs various job control cards to execute jobs. Through the catalogue procedure function, these cards are made into catalogues and are kept registered so that they can be called up easily. This greatly saves labor for the programmers and operators.
• Dynamic Allocation of the Main Memory
The area of the main memory can be dynamically allocated as required when executing a job or it can be divided into any specific sizes in advance.
In either case, the main memory can be most effectively used with small overhead time.
• Independence of Peripheral Units
In processing the sequential file, programming machines are not needed to be specified for the MOD IV since it can use any one of the magnetic tape unit, mass-storage, card reader and high-speed line printer.
• Protection for simultaneous use of file and record
When multiprogram processing is being executed, sometimes more than two programs have access to a file or record in the mass-storage at a time. The MOD IV is provided with a function which restricts it, if necessary, and allows a program to have access to a file or a record.

• Communications Subsystem

The communications system is responsible for controlling the on-line real-time processing. It controls communications lines and terminal units, transmits and receives data to and from terminal units, checks errors, performs message buffering and editing, prepares communication job schedule and switches over the communication jobs. It is incorporated in the MOD IV for application at the time of system generation. Communications jobs are executed in form of a multi-task and up to 20 tasks can be simultaneously carried out. For example, the following tasks can be carried out at a time in accordance with their priority :

1. Making inquiries
2. Data gathering
3. Message exchange
4. Data distribution
5. Reading in jobs from remotely located terminal units
6. Transfer of job output to remotely located terminal unit.

Communication job program is written by the assembler or COBOL, and can be easily prepared in the ACCEPT/DISPLAY Statement and there is no practical limit to its on-line application for the MOD IV.

OPERATING SYSTEM MOD IV EXTENDED

The Operating System MOD IV Extended is used for the NEAC-Series 2200 Model 700 single processor system. It is designed to achieve the following objectives :

(1) To make best use of the Model 700's hardware functions.
(2) Not only to include all functions provided with the Model 500's operating system but also to have new, convenient functions for users.

The MOD IV Extended can be configured with magnetic disk units as its key installation to reduce the system overhead.

The following considerations are included in Objective (1).

(1) The main memory is assigned block by block and the physical addressing can be specified, as desired, through CF (configuration control unit).
(2) The capacity of the main memory is 2097 KC and user's program compiled by more than 512 KC can be prepared.
(3) High-speed channels can be used.
(4) The input/output data are completely protected since an input/output storage protection is provided.
(5) Re-configuration is possible since the input/output units are linked with CPU by means of a TX (trunk exchange unit).

The dependent programs are compatible with those of the MOD III and MOD IV and the language translator and utility programs provided with the MOD IV can be used for the MOD IV Extended.

The core of the control programs is the same as that of the programs for the MOD IV but the program functions are much more improved as follows:

(1) Computer can be used regardless of the user's program volume (in the form of the relocatable system).
(2) Since the job priority, which specifies priority order of the jobs, and the task priority, which specifies the CPU (central processing unit) dispatching for multiprogramming, are separately clarified, the computer system can be flexibly operated.
(3) High-speed magnetic drums can be provided.

Though it is a matter of course, the MOD IV Extended can execute real-time processing, remote batch processing and batch processing.

OPERATING SYSTEM MOD VII

The Operating System MOD VII is used for the Model 700's dual system having two central processing units. It schedules independent job stream for each central processing unit. With the MOD VII, the two central processing units share files and the input/output units are systematically linked to ensure the highest system performance.

The Operating System MOD VII was designed to ensure:

(1) High availability.
(2) Improved performance.
(3) Use of all job processing systems provided with the MOD IV (real-time processing and batch processing can be executed through the multiprogramming and routines for remote batch processing are provided).
(4) Execution of maintenance program without shutting down the system.
(5) Preparation of control programs so that users can select them to meet their application purpose.
(6) Having the same interfaces between the language translator, service program and user's program, and the control program as with the MOD IV Extended.
(7) Preparation of user's program compiled with more than 512K words.
(8) Use of all language translator and utility programs provided with the MOD IV Extended.

ON-LINE REAL-TIME SYSTEM-NEAC TSS

Time Sharing System

The development of a time sharing system which utilizes high-performance, large-scale computers that use terminal equipment installed in remote places has opened up a new application field for computers.

Nippon Electric Company's Time Sharing System was the first of its kind in Japan.

NEAC On-Line System, adopting NEAC-series 2200 Model 500 as a central computer, provides on-line real-time processing, besides compuser's original use as a device for simple calculation.

NEC's seat reservation and banking systems embodying this concept are currently in service in various fields. in these systems, data fed into a number of outlying terminal equipment overlinking communication lines converge into a giant central computer for integral real-time processing where, if necessary, results can be sent back immediately to any terminal.

The NEAC time sharing system is a later and more advanced development of this information-handling technique, embodying the most efficient use of electronic computers. People at remote locations can simultaneously gain access, through their terminal equipment, to a central computer and utilize its powerful capabilities.

The Model 700 NEAC Time Sharing System is provided with functions to perform multiple batch processing by utilizing idle time of the time sharing as with the Model 500 NEAC Time Sharing System. Besides this, the processing capability of the system is greatly improved through the effective use of high-speed central processor and high-speed magnetic drum unit as a roll-in/roll-out file and system reliability is also improved by perfecting its module.

The NEAC Time Sharing System can offer services through the Operating System MOD III as its background program and time sharing services as its foreground program.

EASYCODER ASSEMBLY SYSTEM

Several Easycoder versions are provided to meet the needs

of all system sizes and compositions. This flexibility includes provisions for all types of peripheral configurations and takes advantage of increased internal and input/output processing facilities where available. Additional Easycoder functions, included in versions for systems having the requisite equipment, include:

Maintenance of Symbolic Program File–A file of Easycoder source programs is input to each assembly run and is updated as specified by the programmer.

Selected Assembly—Run tapes contain specific programs selected by the programmer from both an input deck of new programs and a tape file of previously processed symbolic programs.

Library Facilities–A basic tape library of general-purpose routines is furnished by NEC to perform common jobs; to this the user can add his own often-used programs and routines. Programs in the library can be conveniently assembled into an object program by the use of macro instructions.

The Easycoder assembly language includes easily remembered operation codes which are abbreviations for the names of programming statements that the Assembly Program can interpret. For example, the mnemonic S1 is the operation code for the Set Item Mark statement, which is the direct counterpart of a NEAC-Series 2200 machine instruction. The mnemonic ORG, on the other hand, is the operation code for an Origin statement, which is not assembled but which directs the Assembly Program in allocating memory space to the succeeding statements.

A typical Easycoder statement may consist of a tag, a mnemonic operation code, one or two operand addresses (or literal operands), and one or more variant characters. Addresses may be either absolute decimal numbers or symbolic tags. The normal placement of these elements is shown here.

COBOL COMPILER SYSTEM

COBOL consists of a language which is a standardized, business-oriented subset of English and a processing system called a compiler. The programmer describes a solution to a business problem in COBOL language, and then the processing system generates machine-language instructions capable of performing the operations described by the programmer's statements.

COBOL Language

The English-language statements of COBOL provide a relatively machine-independent method of expressing a business-oriented problem to a NEAC-Series 2200 computer. Commonly used nouns, verbs and connectives are used in the procedural portion of a COBOL program to construct easily understood sentences. The excellent documentation provided by COBOL-problem definition as well as method of solution enables more than one programmer to work on a particular problem with minimal duplication of effort.

COBOL Compilers

To complement the modularity of the NEAC-Series 2200 hardware, the various COBOL compilers implement a set of language modules, expanding the features of COBOL as the machine capacity is increased. This design approach allows the COBOL user to enhance the power of the source language and to produce larger object programs as the need arises.

The NEAC-Series 2200 COBOL compilers are syntax-directed; the smallest version can operate in a configuration consisting of three magnetic tape units, a card reader, an on-line printer and a processor containing 8192 characters of memory. (Most competitive compilers possessing a comparable set of language elements require a memory about three times this size.) Other compilers are available for memory sizes of 16,384 characters and larger. NEAC COBOL compilers are known for their high performance and the smallest version of the NEAC-Series 2200 compiler is no exception: Compile times for typical programs run on a NEAC-Series 2200 processor are on the order of one to two minutes.

All NEAC-Series 2200 COBOL compilers are modularly expandable and self-adapting to memories larger than the minimum. They accept batched source programs and will operate in a batch-compile, load-and-go mode.

The NEAC-Series 2200 COBOL compilers possess several significant operating features:

1. Maintenance facilities for source-language files
2. An object-time, data distribution system plus dynamic and static dumping facilities to expedite program testing.
3. Dynamic reassignment of read/write channels at object time.

FORTRAN COMPILER SYSTEM

The NEAC-Series 2200 FORTRAN Compiler System consists of two basic elements: a source language (FORTRAN IV) whose structure closely resembles the language of mathematics, and compilers which translate the statements and formulas written in the source language into NEAC-Series 2200 machine-language programs.

FORTRAN Language

Programs are written directly as algebraic expressions and arithmetic statements. Additional statements, such as transfer, decision, indexing and input/output statements, control the processing of the algebraic expressions and arithmetic statements. The smallest compiler version translates a major portion of FORTRAN IV, including logical statements and testing, data initialization, labeled COMMON areas, and type statement declarations. Even more sophisticated language elements are accepted by the larger versions.

FORTRAN Compilers

All NEAC-Series 2200 FORTRAN compilers are designed for rapid compilation and optimum efficiency of object coding. Translated programs can be combined with other previously compiled and assembled programs and immediately executed to obtain fast results. The smallest version requires as few as 16,384 characters of memory, plus four magnetic tape units, a card reader, card punch and printer. Larger versions, which exploit the added features and instructions of the scientific hardware option, can process programs utilizing very large core storage capacities, up to 524,288 characters. Special features of the FORTRAN compilers include object code optimization and a highly sophisticated diagnostic system.

LIBERATOR CONVERSION PROGRAMS

The Liberator concept, an integral design feature of every NEAC-Series 2200 processor, permits users of a number of older systems to enjoy the benefits of these processors without the cost and effort of reprogramming. This concept has many facets, including compatibility of programming languages, data formats and peripheral input/output devices. Because NEAC has realized the compatibility dimension in hardware design, programs written for the IBM 1401, 1410, 1440, 1460 and 7010 systems need only be converted once in order to run on processors 100/150/200/250/300/400/500/700 without the aid of inefficient simulators and usually

in a fraction of their original execution time. This conversion can be achieved using any one of a series of available programs in the following major categories:

1. Easytran, which converts programs at the symbolic level, operating either on a NEAC system or on a 1400-series system.
2. Bridge, which converts programs at the machine level, operating on NEAC equipment.

Easytran—Symbolic Language Conversion

Easytran is a conversion program which accepts input symbolic source programs written in SPS and/or Autocoder language. The source program is completely analyzed and then translated statement by statement. During this process, most symbolic statements are replaced on a one-for-one basis with equivalent Easycoder statements. Those statements which have no direct Easycoder equivalent are replaced either with in-line macrocoding or with calls to Easytran subroutines which perform the desired functions; those whose functions are automatically handled by the NEAC-Series 2200 hardware are deleted. The principal output of Easytran is a symbolic program in the proper form for input to the Easycoder Assembly System. Additional outputs include a parallel listing of the Autocoder and Easycoder symbolic programs, a cross-reference listing of all labels (tags) used in the input program, and an English-language diagnostic which points out any areas where programmer hand-tailoring may be required.

Bridge-Machine Language Conversion

Translation of 1401-series programs at the machine-code level is performed by the program Bridge, operating on NEAC equipment. The principal output of Bridge is an operable object program in either single-card or condensed-card load format, or in the form of card images on magnetic tape. Translation also produces a side-by-side listing of the original and the converted programs. Flags in the listing signal any questionable entries the conversion of which should be checked by the user. Those instructions which cannot be converted on a one-for-one basis are replaced by calls to the object time package, a group of subroutines which are entered as required at execution time. The object time package improves the efficiency of the converted program by automatically overlapping input/output operations to take advantage of NEAC peripheral simultaneity.

The memory mapping of the original program is retained by Bridge. This feature facilitates any machine-language changes that may be required in the converted program and enhances the usefulness of the original program documentation.

GENERALIZED DATA MANIPULATION PROGRAMS

In addition to program preparation aids, NEC also provides an extensive array of software to relieve the user of the tedious and complex task of programming such common jobs as sorting, input/output operations and report generation. Many of these generalized programs are offered in two or more versions, each specifically tailored to take fullest advantage of a particular range of equipment configurations. Different methods in input/output controls are also considered corresponding to each aforesaid level.

For example, in the level of Operating System MOD I or MOD III, data transfer between central processor and peripheral device may be concentrically handled by only an I/O control routine. In the level of MOD I or EASY Programming System, many kinds of I/O control routines correspond to each peripheral device to control data transfer respectively. This is because the most efficient uses of a computer are aimed at according to its memory capacity.

Magnetic Tape Input/Output Package—TIP-TOP

Implemented to handle both NEAC and competitive data conventions, the tape input/output control package provides object code, as directed by macro instructions, to perform the following functions: reading and writing tape records, blocking and unblocking of items within records, opening and closing files, and detection and automatic correction of errors. Both fixed and variable-length records are handled by TIPTOP.

Paper Tape Input Package—PIPPOP

The input package for paper tape systems—PIPPOP—can handle 5-, 6-, 7- or 8-level paper tapes. PIPPOP performs all input functions stated above for PIPPOP with the added capability for data editing. Exits are also provided to a user-supplied code conversion table.

Tape Sort and Collate Programs

These are generalized programs which adapt themselves, as directed by programmer-specified parameters, to operate in a particular hardware configuration and to sort and collate data in a particular format. All of the sort programs take advantage of the industry-acclaimed Polyphase sorting technique developed by NEC. Tailored for use in small systems is a sort program which requires only three tape units and receives its specialization parameters by card or paper tape. This program sorts fixed-length records of up to seven keys and provides facilities for self-coding.

More advanced sort programs are furnished for use in larger systems. These programs provide the added advantages of read-backward Polyphase sorting and the ability to handle variable-length records. A sort program can be automatically linked to a series of related operations by coding the preceding program to establish the sort parameter values before it terminates. These programs are also self-adapting to memories larger than the minimum.

For use in conjunction with each of the sort programs, when needed, a collate program is available. The collate program accepts two or more sorted files and combines them to produce a single composite file in proper sequence.

Scientific Subroutines

The NEAC-Series 2200 users have available to them an extensive library of scientifically-oriented subroutines which complement the capabilities of the Fortran compiler. This library includes the usual basic Fortran routines, such as square root, exponential, logarithmic and trigonometric functions, as well as matrix, statistical and other more comprehensive routines. All of the subroutines in this library can be used with or without the scientific hardware option.

Tabulating Equipment Simulation—TABSIM

A tabulating equipment simulator, TABSIM prepares printed reports from an input consisting of a deck of punched cards (or a tape file of card images). The input deck contains control cards and data on detail cards. In general terms, the output report represents the data on the detail cards, edited and processed arithmetically.

Report Generator

NEC furnishes a program for automatic creation of reports according to user specifications. To use the report generator, the programmer merely prepares a set of parameters defining control fields and report lines. These parameters are used as input to the report generator, which produces a symbolic program.

The assembled version of this program accepts raw data from cards of tape, edits it, and generates the desired reports.

SOFTWARE FOR RANDOM ACCESS DEVICES

NEC offers a comprehensive array of programming and operating aids for the NEAC-Series 2200 drum user, including a Drum Loader/Monitor, a program for updating program files on a drum, a special drum sort, input/output routines and utility routines.

Random Access I/O Package—DIPDOP

Direct, serial and random processing of drum files are provided by this control package. Easycoder macro instructions are available to direct the performance of the following drum input/output functions: Direct-Address Processing-Reading or writing of data from a sector whose address is given. Serial Processing-Reading or writing of the item following the one currently being processed.

Random Processing-Transfer of an item between core memory and a drum location whose address is determined by mathematical transformation of the item's key.

Random Access Sort

A separate program is furnished to sort data stored on magnetic drums. This program obtains the item keys of data stored on a drum, sorts the keys, and then stores on the drum a table containing the keys and the addresses of the corresponding file items. Items may be brought in from the drum in the order of the sorted keys by using the Easycoder macro instruction FETCH.

The drum input/output package processes either fixed or variable length items and blocks and unblocks items within records. To further assist the user, it also affords facilities for detection and automatic correction of errors.

Random Access File Utility Routines

NEC has designed a "package" of generalized utility routines for use at drum installations. The jobs performed by these routines include the following:

Examining the contents of a drum file.

Transferring a file between a drum and punched cards or magnetic tape (the transfer may be in either direction).

Making corrections to a file stored on a drum. The separate routines which perform these functions may be assembled with a control routine to form an independent system called DIAL (Drum Interrogation, Alteration and Loading); or individual routines may be assembled directly into an object program. In particular, Easycoder users may obtain specified DIAL functions by use of macro instructions such as LOCATE, UNLOAD, RESTORE, EDIT, CORRECT, COMPARE and CLEAR.

NEAC-Series 2200 Character Codes

Key Punch	Card Code	Central Processor Code	Octual	High-Speed Printer	Key Punch	Card Code	Central Processor Code	Octual	High-Speed Printer
0	0	000000	00	0	–	X, 0 or X(*)	100000	40	–
1	1	000001	01	1	J	X, 1	100001	41	J
2	2	000010	02	2	K	X, 2	100010	42	K
3	3	000011	03	3	L	X, 3	100011	43	L
4	4	000100	04	4	M	X, 4	100100	44	M
5	5	000101	05	5	N	X, 5	100101	45	N
6	6	000110	06	6	O	X, 6	100110	46	O
7	7	000111	07	7	P	X, 7	100111	47	P
8	8	001000	10	8	Q	X, 8	101000	50	Q
9	9	001001	11	9	R	X, 9	101001	51	R
	8.2	001010	12	,		X, 8, 2	101010	52	#
#	8.3	001011	13	=	$	X, 8, 3	101011	53	$
@	8.4	001100	14	:	*	X, 8, 4	101100	54	*
Space	Blank	001101	15	Blank		X, 8, 5	101101	55	⁄
	8.6	001110	16	>		X, 8, 6	101110	56	≠
	8.7	001111	17	&		X or X, or O(*)	101111	57	1
&	R, O or R(*)	010000	20	+		8.5	110000	60	<
A	R, 1	010001	21	A	/	0.1	110001	61	/
B	R, 2	010010	22	B	S	0.2	110010	62	S
C	R, 3	010011	23	C	T	0.3	110011	63	T
D	R, 4	010100	24	D	U	0.4	110100	64	U
E	R, 5	010101	25	E	V	0.5	110101	65	V
F	R, 6	010110	26	F	W	0.6	110110	66	W
G	R, 7	010111	27	G	X	0.7	110111	67	X
H	R, 8	011000	30	H	Y	0.8	111000	70	Y
I	R, 9	011001	31	I	Z	0.9	111001	71	Z
	R, 8, 2	011010	32	;		0, 8, 2	111010	72	@
•	R, 8, 3	011011	33	.	,	0, 8, 3	111011	73	,
□	R, 8, 4	011100	34	)	%	0, 8, 4	111100	74	(
	R, 8, 5	011101	35	%		0, 8, 5	111101	75	CR
	R, 8, 6	011110	36	■		0, 8, 6	111110	76	□
	R, or R, O(*)	011111	37	?		0, 8, 7	111111	77	¢

(*) Special code, designated by a card or punch PCB instruction, which provides compatibility with NEAC 2400 and 2800 systems.

APPLICATIONS SYSTEMS

To supplement its hardware and computer management software, NEC provides its customers with application systems —extensive, packaged solutions to business problems. They represent a major NEC investment and incorporate the information and knowledge NEC has acquired through many years of experience in working with customers in almost every industry. Application systems are designed for customers either as ready-to-implement packages offering immediate productivity or as guide-line packages to be used whenever a user wishes to develop a partially or a completely new system.

Third-generation NEAC Series 2200 computers provide an infinite potential for the handling and management of data. Application systems are extremely valuable to a company whether it is taking its first venture into electronic data processing or acquiring a replacement computer for greater data processing capability. By applying the appropriate application system, the user can significantly reduce the amount of effort required in planning his initial and subsequent applications, developing an integrated system, and solving a variety of management problems. Extensive documentation permits complete understanding of the capabilities of a particular system.

MANAGEMENT SCIENCE

SCIENTIFIC DATA PROCESSING SYSTEM

Numerical Calculation Library

Programs through which numerical calculation, the most basic calculation of scientific technology, is worked out, are available as FORTRAN Library.

Linear calculations ·····converse matrix, simultaneous linear equation, eigenvalue specific vector, determinants

Algebraic equations ·····simple algebraic equation, of higher degree, plural algebraic equation

Special functions ·····gamma function, etc.

Multinominal operations, numerical differential and integral, differential equation and integral equation.

Statistics Library

A voluminous FORTRAN Library is also available for statistics science where a large amount of data—such as observational values and empirical values—are processed.

Estimation and Test—

Probability density and distribution—

Random Number Generation—

Experimental Design—

Relative and Regression—

DESS—Differential Equation Solving System

The DESS is a system designed with an aim to solve regular differential equations.

This system eliminates the need for compilation even if regular differential equations are changed, and affords very effective use of the computer. If the programmer, by drawing a block diagram shows the solving procedure of the given regular differential equation, feeds the system input made from the block diagram, the system automatically advances time and gives answers continuously for the change of time.

STATISTICAL ANALYSIS

Factor Analysis

The factor analysis package consists of four subsystems, and is used for statistical analysis—such as marketing surveys, sales surveys and advertising surveys. The analyzing data are not fed in the form of numericals, but data expressed by the classification and characteristics of analysis are processed. Namely, the reaction and observational value for the item category of samples are fed as inputs and the category volume of each item category is worked out. The output is given in the form of a correlation coefficient, a regression coefficient and standard deviation in addition to the category volume.

PEP—Parameter Estimation Program

The PEP estimates the parameter in non-linear equations. Namely,

$$Z=f(W, X, Y: \theta_1, \theta_2, \cdots\cdots, \theta_p)$$

where Z is expressed by variables and function of parameter, function f of a proper model is given and the parameters $\theta_1, \theta_2, \cdots\cdots, \theta_p$ are estimated. Accordingly the program can be widely applied to determine growth curves and demand curves or demand estimation and also to engineering calculations.

STAT—D, K

This is a general purpose package for statistic calculations—such as estimation, statistic control and surveys. The following methods of calculation are included in this package:

- Volume of standard statistics, histogram, graph plot
- Analysis of variance, analysis of factor, method of least squares
- Correlation analysis, regression analysis.

SIMULATION

EGPS—Extended General Purpose Simulator

For simulation, model assembling and programming are needed and the EGPS was developed to simplify and ease the two tasks. To simulate such systems as traffic systems and on-line computer systems, a block diagram is fed to the computer.

Features

- System consists of about 30 blocks. Number of the blocks varies depending upon configuration.
- A maximum of 4000 blocks can be defined for one system.
- A maximum of 4000 transactions in a system at a time.
- A maximum of 100 parameters can be defined for a transaction. The parameter can handle floating point decimals in addition to integers.
- In addition to the indirect specification by the parameter of transactions, indirect specification by cell is also possible. Sampling functions allow intermediate rates of the simulation to be noted.
- The maximum number of entities to support the block can arbitrarily be determined by the operator.

GPS—General Purpose Simulator

To simulate the systems having operational flow as in the case of the EGPS, a block diagram is fed to the computer. The GPS is a compact type of the EGPS and can simulate computer systems with its small memory. It is compatible with the IBM 7090 GPSS-Ⅲ.

DYNAMO

The DYNAMO is a system designed for industrial dynamics. It systematically grips the structures of industry and economy as a flow of materials, orders, money, manpower, facilities and information, and offers important, effective means of decision-making to the management.

The DYNAMO simulates models expressed by equations on the basis of feedback theory.

Facilities Investment Simulator

Investment to the facilities offers bright possibilities of growth to the enterprise, and involves most important strategic determination of managerial will. The Facility Investment Simulator is a system designed to assist the management approaches to such an important problem.

The expected earning rate distribution of the investment plan is worked out by quantitatively simulating the uncertainty of factors related to the investment and the investment effectiveness is judged from it.

The program was designed on the basis of the standard functional module and the program can be modified to be suitable for various managerial purposes, by modifying or adding specific functions.

Budget Simulator

A budget must be prepared quickly and correctly, and is revised again and again until it is finally settled. The procedure of budget preparation is simulated by the computer through this budget simulation program.

Since the budget is a very important and effective management tool, the management must systematically grasp the interrelationship of the important departments. The Budget Simulator was designed with due consideration in this regard, and will help you prepare a much better budget. Accordingly, it will be useful to lay a foundation for a total system or a large-scale business simulation program.

LINEAR PROGRAMMING

The method that deals with uni-dimensional problems for both initial conditions and objective functions, is called linear programming and gives a very effective means to solve management allocation problems, production schedules, material handling and transportation, etc.

LP-SUB

A small-scale LP sub-routine, which can be easily used as a FORTRAN sub-program in user's program. It is used to solve small LP problems for engineering calculation.

LP-D

The LP-D is used to solve maximum and minimum problems through the revised simplex system. It can solve an initial condition involving about 80 expressions when its main memory capacity is 16,384 characters, and an initial condition involving about 270 expressions when its main memory capacity is 32,768 characters.

LP-E

A program designed to solve transportation problems very efficiently.

LP-H

The LP-H incorporates all functions provided with the LP-D in addition to its own functions. It is used to analyze the correctness of optimum solutions and for parametric programming. It can also handle several right sides and objective functions.

LP-K

The LP-K is a system which was developed to solve large-scale linear problems, and has all analyzing control cards now available.

MPS—Mathematical Programming System

The MPS, a third generation general purpose mathematical programming system incorporating the latest techniques related with the linear programming, processes large-scale linear problems very quickly.

It can handle linear programming calculation (correctness analysis, parametric analysis, finite variable), integral linear programming caculations and local linear programming calculation.

The system is systematically controlled by the control language which controls the flow of calculation.

Provided with a matrix generator, the MPS makes coefficient matrix from the input data, and carries out various calculations to prepare reports.

NETWORK ANALYSIS

Project being undertaken by enterprises involve many complex interactions and how to control planning and distribution of expense and resources is very important.

The NETWORK ANALYSIS is a very useful management system which expresses minor activities included in the large projects in the form of a network and controls the progress of the projects, time, expense, resources, etc. Through the Network Analysis, projects can be quickly and accurately planned, evaluated and executed.

Various PERT systems are available for selection.

PERT A

This is a considerably small-scale PERT/TIME program and is provided with Barchart function which conventionally was used for the schedule control.

The PERT A can be used with the main memory having a capacity of 4096 characters or more.

PERT C and D

In addition to the same functions provided with the PERT A, the PERT C and D have additional functions so that all kinds of a single network PERT/TIME calculation can be performed.

PERT K

If a project is very large, it is very difficult to integrate it under one network because many activities are involved.

The PERT K integrates networks (sub-networks) prepared by departments into one through the computer, and performs calculation.

In each subnet, up to 1000 activities are processed.

One or three time estimations can be processed on daily or weekly basis.

The number of start events and end events are not limited.

PERT/COST

This is intended for the simultaneous control of time and cost of a project. The progress of the project is controlled financially by the continuous comparison between the estimated cost and the actual cost.

- The cost is associated with each activity. It can also be given to time.
- The cost of each activity can be given directly in amount or in quantity in given units or code.
- Batch processing and updating of a number of networks are possible.
- The output involves the calculation results of PERT/TIME and its summary report, bar chart, results of cost calculation, and cost curve plotting.

PERT/MANPOWER SCHEDULING

When the execution of a project is subjected to the restriction on the number of machines and workers and on the quantity of raw materials, PERT/MANPOWER is employed to obtain the time of starting and completion of each work so that the shortest work schedule under the restricted working conditions may be attained.

ECONOMETRIC ANALYSIS AND DEMAND FORECASTING

Economic activities are unfolding various aspects every day, every time. For such changes, the industry must take a proper action.

In that sense, a program for grasping and analyzing the economic activities and forecasting their future contributes to the industry with the in-time advantage.

GPFS—General Purpose Forecasting Simulator

When forecasting economical conditions, the GPFS is used to obtain the optimum estimation by evaluating the past actual results from the time series data while adjusting seasonal variation.

Forecasting can be done with the most optimum equation selected among 10 forecasting models prepared for internal forecast. This process is controlled automatically by simulation.

- By the use of time series data as inputs, an optimum forecasting equation with the highest adaptability is selected among 10 forecasting models using in combination the method of least squares, the method of moving average, and the method of exponential smoothing.
- Outputs can assume graphical patterns.
- Since it is made possible to generate time series data inside, GPFS can serve satisfactorily as a simulator.

Census Method IIX-10

Accurate knowledge of economic activities is of foremost importance for demand forecasting. It is necessary to know, as fast as possible, the change of actual status of each economic index upon systematic studies. Economic data available monthly contain various variable factors. Therefore, it is important to separately grasp the factors through some processing of the original data.

CENSUS is a very effective means to separate seasonal change factors.

- Capable of discriminatively grasping original series data such as tendency change, industrial fluctuation, seasonal change and irregular change.
- Capable of discerning irregular changes which cannot be grasped otherwise, applying to the seasonal change adjusting series by means of the moving average method.
- Capable of obtaining values up to both ends of the series.
- Capable of handling data over 10 years as a time series data.
- By feeding in time series data as an input, the forecasting is performed through 10 different forecasting equations combining the method of least squares, method of moving average and method of exponential smoothing and the optimal equation is selected.
- The output can be given in the graphical patterns.
- Since the time series data can be generated internally (random number generation), the GPFS can function as a simulator.

CENSUS—CENSUS Method IIX-10

To grasp the economic trend correctly is a major proposition for demand forecasting. For this, economic indices must be systematically studied to know the change of the actual situation of each index as fast as possible. However, economic data involve various factors and the original data must be processed to separate these factors.

The CENSUS features its excellent capability in separating factors which change by seasons.

- From the original data, secular trend factor, cyclic part factor, seasonal variation factor and irregular fluctuation factor.

Econometric Analysis and Demand Forecasting

- Irregular fluctuation factor, which cannot be separated by the normal method, is separated by applying the method of moving average to the seasonal variation.
- As time series data, monthly data in 10 years can be processed.

FIRMS—Forecasting Information Retrieval and Management System

The FIRMS is a general purpose forecasting system in which various forecasting techniques are systematized, and meets various forecasting requirements in various fields of companies, government and other organizations.

The FIRMS can be widely used for time series analysis and econometric analysis through equations, data transformation, seasonal adjustment periodic analysis and trend analysis.

- Problems are expressed by simple FIRMS language and are fed into the computer.
- All kinds of data are integrated as in the case of a data bank and through the information retrieval technique unified information is freely sampled.
- Among results obtained through various methods, the optimum result can be selected.
- The analyzed result is plotted and can be given in a graphical pattern.

Information Retrieval System

As a result of the remarkable technical innovations and economic progress made in recent years, the amount of information has increased tremendously in every field. And, the information acquired has tended to be diverse and intricate.

To cope with this matter, such information processing functions as collection, assortment and retrieval are of extreme importance. A system comprising these functions is known as the "IR (Information Retrieval) System" and has experi-

enced a noticeable progress in recent years.

- Documents Information Accessing System: DIA
  The DIA System is to meet the user's requirements of the various information, provided with every necessary function for the Information Retrieval System, especially for the Documents Information Accessing System.
  Input data are as follows:
  Numbers of literatures: names of authors: author's belonging body; name of magazines and books; volumes; numbers; dates of issues; titles; excerpts; texts; classification numbers; key words; categories of subject.
  The outputs can become an index library for the unspecified many, and Q-A (Question & Answering) for specific individuals. The index library is available in several versions; bibliography list, classification index, key word index (key word in context and key word out of context), author index, etc.
- DIA-R
  This performs the information retrieval of the scientific documents as the sub-system of DIA.

Production and Inventory Control System

Various functions and activities of each enterprise are closely and organically bound to each other, and to effectively perform its operation most important is to clarify its functional significance as part of the whole, and simultaneously from the comprehensive aspect as a whole.

FACTOR system (FACTORY MANAGEMENT INFORMATION SYSTEM) can furnish an overall system approach for the above purpose.

The management system is rather roughly divided into four areas; management planning, production, sales and accounting. Various subsystems in each area include all capabilities of the enterprises, particularly manufacturers.

- FICS (Forecasting for Inventory Control System)
  This has been developed as a subsystem for inventory control in Factory System, and is intended for controlling inventory based on forecast in order to reduce the storage cost, improve the customer services, and adjust the production or procurement by the demand variation.
- The demand forecast is done by the exponential smoothing method.
  Smoothing equations of uni-dimension, bi-dimension and tri-dimension are applied to the demand for each product attained during the past 12—24 month period, with smoothing constant α being shifted from 0.1—0.5, whereby the demand is analyzed for selection of the optimum forecast value and determination of parameter α.
- Conventional concepts of EOQ, safety stock, and reorder point are employed for inventory control.

The parameter for inventory control is obtained from the forecast value selected as the optimum and other factors of each product including carrying cost, ordering cost, percentage of customer services, standard unit cost, lead time, etc., and the inventory control is conducted by the ordering point method.

- ISIM (Inventory Simulation System)

The effect of inventory control by FICS is simulated and evaluated using the data obtained in the past.

- By applying the method used in FICS to the past data, optimum smoothing constant α is selected, thereby to prepare an analytical report containing the smoothed value, forecast value, mean absolute deviation and the sum of errors.
- Based on the selected parameter α, the parameter for inventory control, EOQ, safety stock and the reordering point are calculated to prepare the inventory report of each product which shows variation of average stock, out-of-stock percentage, and stock at the end of each month.
- Thus, ISIM serves to indicate the effect of customer services upon the inventory when any change of the services arises.
- TABS (Tape Bill of Materials System)
  This has been developed as a subsystem of Factor System for calculation of parts and materials. In the manufacturing industries, the production quantity is determined either by demand forecast or on the basis of the secured orders. For satisfactory production activity, it is essential to have the accurate knowledge of the quantity of the necessary parts and their raw materials. Calculation of components and their raw materials becomes complex in case a change or revision is effected to the drawing.

In this case, business machine processor employing the product structure method is quite effective.

- The parts list file is prepared and updated.
- The quantity of component parts and their raw materials are calculated according to the kind and quantity of the product.
- The netting of estimated requirements against available inventory is performed if occasion so demands.
- Parts lists giving the quantity of raw materials (bills of materials) calculated to be required and available for specific products are prepared.
- Cost files are updated for comparison with such information as the standard cost and actual expenses.

PRODUCTION AND INVENTORY CONTROL SYSTEMS

FICS—Forecasting for Inventory Control Systems

The FICS is used for inventory control based on the forecasting to reduce expense required for products in stock, to improve services for customers and to control production or purchasing in accordance with the variation of demand.

- Demand is forecasted through exponential smoothing.
  Through exponential smoothing, the demand for each product in the last 12 to 24 months is analyzed by using the single, double and triple smoothing constants α of 0.1 to 0.5 to select the optimum value and a forecasting parameter α is determined.
- Inventory control system incorporates the concepts of conventional EOQ, safety stock and re-ordering point systems. Namely an inventory control parameter is worked out on the basis of the estimation selected as the optimum forecast, storing and carrying cost per product, customer service rate, standard unit price of product and lead time and inventory control is performed through an ordering point system.

ISIM—Inventory Simulation System

The ISIM is used to evaluate the effectiveness of inventory control through the FICS by simulating the actual data obtained.

- Based on the technique used in the FICS, the optimum smoothing contant α is selected by using the obtained data to prepare an analytical report including a smoothing constant, forecast value, mean absolute deviation and sum of error.
- Inventory control parameter EOQ, safety stock and re-ordering point are calculated through the selected smoothing

constant α. The stock status - such as average stock, out-of-stock ratio and month-end variation of stock - are stated in the report.

- Accordingly, the influence to the stock condition when customer service policies were changed can be known immediately.

TABS—Tape Bill of Materials System

TABS is an application package for the manufacturing industries which performs three functions in the bill of materials area: It maintains the bill of materials master file, prepares printed bills of materials, and explodes bill of materials for planning purposes.

- B/M file can be updated.
- Bill of material is executed - according to the category and quantity of the products, the quantity of their parts and materials are calculated.
- B/M report - "where-used list", "what-used list" and "levelized B/M" - is prepared.
- Accounting files are maintained for making reference to the standard cost and actual cost.

Rapid growth of economy and remarkable technical innovations have resulted in a tremendous increase of information in various fields of activities and the information has become qualitatively more complex. To cope with this trend, it has become necessary to provide computers with a function to collect, readjust and search information. Such a function is called the information retrieval system which has shown unexceptional development.

DIA—Documents Information Accessing System

Provided with a complete function as an information retrieval system, especially for documental information, the DIA can meet users' all possibel requirements. The following information can be fed as inputs:

Document number, authors' names, and organizations the authors are associated with

Names of magazines and books, number and volume of the magazines and books and date published

Titles, summaries, original manuscripts, ke ywords, and classification of the articles.

The outputs are given in forms of indexes for users of unspecific masses and Q·A (question and answering) for a specific individual. The indexes can be classified into "book list", "classification index", key word index—KWIC index (key word in context) and KWOC index (key word out context)—and authors' index.

DIA-R

This is a subsystem of the DIA, and is especially effective for retrieving scientific document information

DIBS—Disk Bill of Material System

Bill of material is an important basic job of the production control system in manufacturing industries. Bill of Material is an act to calculate the quantity of parts required for the manufacture of a product.

As bill of material program packages, there is a system called the TABS consisting of magnetic tapes in addition to the DIBS, which uses a disk pack to improve accuracy and operating speed. The DIBS is provided with such additional functions of loading and scheduling.

The DIBS is provided with three levels as follows:

Level 1: The product structure file recording the bill of material data and the part number master file, which corresponds to a parts ledger, are prepared and maintained. The two files are linked by a chain and explosion or implosion is conducted by skillfully controlling the chain and the filed information is retrieved.

Level 2: In addition to the functions with Level 1, the pending change capability is provided.

Level 3: Route sheet file and work center file creation and maintenance functions are additionally provided. The four files are linked by means of chains and data required for loading and scheduling can be conveniently retrieved.

NET GEN NET Requirement Generation System

The NET GEN is a generalized, preprogrammed system which, with DIBS, helps the user to translate end-product and spare parts requirement into a time-based inventory report. The system performs time series analysis for items on an exception basis, producing and posting both replenishment changes and induced requirements.

- STEP (Structural Engineering Program System)

This is a general purpose system intended for bi-dimensional analysis of stress and deformation that should be taken account of in the design of structures. The stress and deformation of a member at the nodal point and the reaction force developing on the fulcrum can be obtained by the Direct Stiffness Matrix Method based on the principles of the derivative method.

- If for each node the position and fulcrum are pointed out, and for each member of framework the characteristic coefficients such as section area, secondary moment of area, and elasticity coefficient (when necessary, shear elastic coefficient, torsion moment), and the connection method at each node is provided, the stiffness matrix for the entire structure will be set up within the program. As for the connection between the framework member and the node, either of the ways which should be taken, that is; the rigid connection, or pin connection, or the combination of the two as aforementioned, and as for the fulcrum, fixing connection, or pin connection, or elastic supporting or the combination of the connections as aforementioned will be specified.
- The following six kinds of load imposed on a structure can be analyzed.

(1) Load and bending moment imposed within the frame plane (provided that both work in the axial direction of the framework member, in the direction normal to the axis of the framework member, and along X and Y axes of a specific coordinate representing the entire structure.)
(2) Load, bending moment and torsional moment working normal to the frame surface.
(3) Temperature variation.
(4) Deliberate deformation of the node.
(5) Traveling load.
(6) Unit load imposed on the specified node (preparation of influence function matrix for analysis of oscillation mode).

- The quantity of nodes, framework members and load conditions that can be processed by a simple run of analysis is as follows in case of 98 K-character capacity.

Nodes	260
Framework members	900
Load conditions	5
Number of loads constituting a single load condition	500

(In case of influence line analysis, traveling of load is possible at 60 load points).

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Cat. No. 614-1-E
7011-2000-M
Printed in Japan