NEC

PARAMETRON DIGITAL COMPUTER

TYPE NEAC-1103

NEC

Type NEAC-1103 parametron digital computer is a large scale computer adapted for general purpose scientific use. This type of machine incorporates many improvements in design as compared with the former type, NEAC-1102, which was also built by Nippon Electric Company.

This machine is a stored program automatic digital computer utilizing "Parametrons", consisting of parametrically excited circuits with non-linear magnetic cores and capacitors as its switching elements for arithmetic operation and control. For high-speed storage system of type NEAC-1103 parametron digital computer, the so-called "two radio frequency method" is used, the principle of which being considerably different from that of the ordinary magnetic core memory system.

Type NEAC-1103 parametron digital computer is designed so as to be applicable to as wide field as practicable, setting up a large number of instructions. With type NEAC-1103, there is no need for relying upon special programmers and further, the number of instructions contained in a program can be made extremely small as compared with other types of computers, whereby programs are set up with extreme simplicity.

In addition, both fixed point and floating point operations can be executed so as to perform automatic programming. This machine is capable of processing easily and readily all kinds of large-scale, complex problems generally called for in various technical departments such as electric communication, electric power generation and transmission, atomic power, aeronautics, shipbuilding, machinery, etc. or in scientific departments such as physics, chemistry, astronomy, meteorology, geophysics, etc. or in economy or statistics. Except for these technical and scientific computations, the present machine can be conveniently used for office computations.

Type NEAC-1103 is an epoch-making large-scale electronic computer having excellent function. Since parametrons are used as operational elements, equipment is long-lived, featuring ease of maintenance and low cost together with a number of unequalled characteristics.

FEATURES

Type NEAC-1103 parametron digital computer has the following outstanding features :

(1) The fixed point system and the floating point system are mutually interchangeable by the instruction "switch". By this instruction, the exponential part and the numerical part may be linked or its link disconnected. Instructions such as "normalize the contents of AR_1" "shift the contents of AR_1 to the right or left until the contents of EC_1 becomes 0" are set up in the computer.

By disconnecting the link of AR_1 and EC_1 and using "instruction regarding Exponent", subroutine programs such as a floating point system using 10 as the base or a fixed point system for placing a point at an arbitrary position can easily be set up.

(2) AR_1 and AR_2 may be used either independently or as a double precision register.

(3) Instructions about short words such as put, add, subtract, clear, store have been set up, and operations about integer such as $+n$, $-n$, $\times n$, $\div n$ are constructed.

(4) Instructions of logical operations are set up.

(5) Instructions of B-box are set up. For all kinds of operations, B-box can be used as $1\frac{1}{2}$ address system.

(6) Instructions of input and output are sufficiently set up. This computer may be read or written by either words or characters or holes of input-output tape. Instructions "Read a long word from the input-tape and store" are set up. This instruction plays an important role in reading the input-tape.

(7) An instruction for reading six holes in tape, instructions for idle sending of tape in the normal and revease directions are set up. By these instructions, equations perforated in tape may be translated into the words of computer.

(8) Checking is possible by simultaneous reading from two readers.

(9) For arithmetrical operations, round-off computations can be performed. For this rounding, the system of dropping 0 while placing 1 to the upper digit place has been adopted.

(10) Without interrupting operations of the computer, transmission of information among magnetic drum, magnetic core, and magnetic tape is possible.
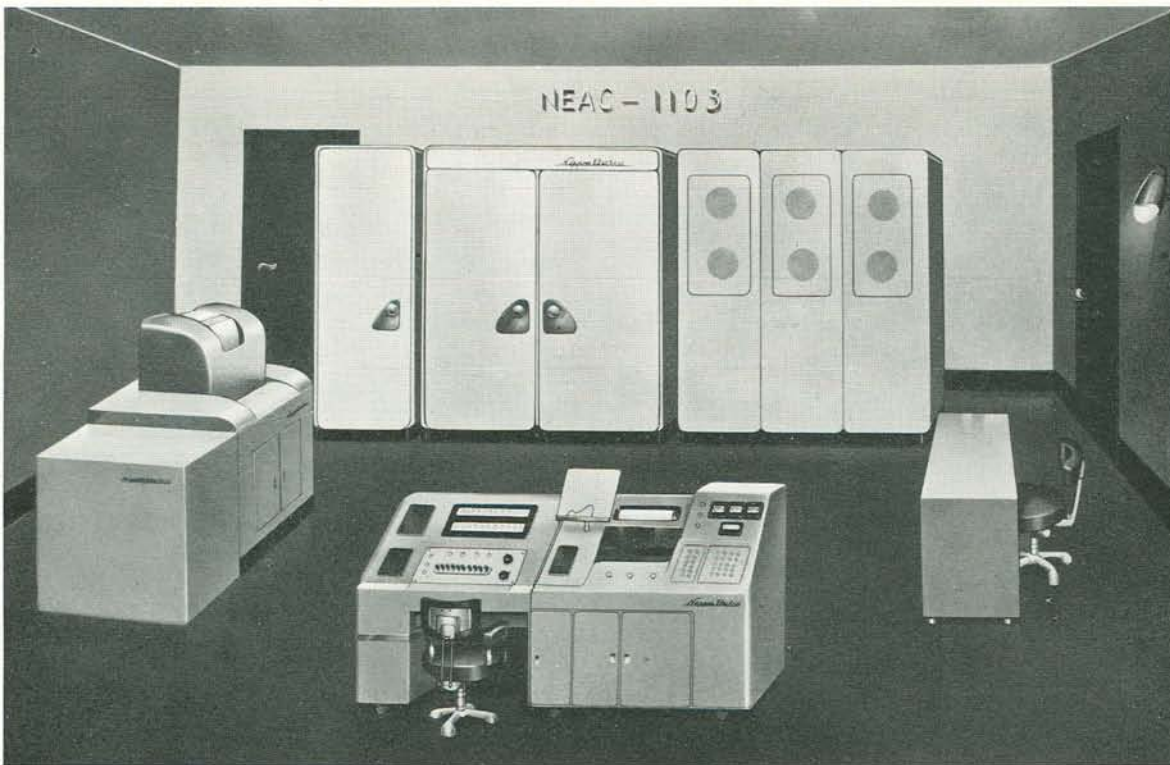
INSTRUCTION CODES

An instruction code for type NEAC-1103 parametron digital computer is constructed as follows:

Number of bits:

Operation part is composed of two sexadecimal numbers T and V, T and V indicating respectively the type and variation of the instruction. The kinds of instruction types and the number of variants belonging the same type are shown below.

Sexadecimal digit V expresses the operation within a certain type, 16 different operations being distinguished. Arithmetic operations can be performed either on fixed point or floating point base, with the result that a maximum of 32 kinds of variant operations can be prepared. For example, the type "addition" is shown in the following table:

Addition:

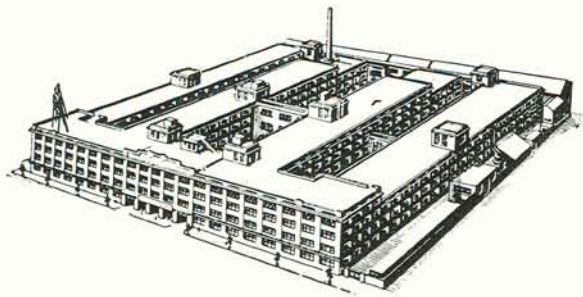|		
02	$C(AR_{1-2}) + C_N(n) \rightarrow C(AR_{1-2})$	$C(AR_{1-2}, EC_1) + C_L(n) \rightarrow C(AR_{1-2}EC_1)$
03	round	round
04	$C(AR_{1-2}) + C_N(n)_1 \rightarrow C(AR_{1-2})$	$C(AR_{1-2}EC_1) + |C_N(n)| \rightarrow C(AR_{1-2}EC_1)$
05	round	round
06	$C(AR_{1-2}) + C_N(n)^{-39} \rightarrow C(AR_{1-2})$	$C(AR_{1-2}EC_1) + C_K(n)2^{-39} \rightarrow C(AR_{1-2}EC_1)$
07	round	round
08	$C(AR_1) + C_N(n) \rightarrow C(AR_1)$	$C(AR_1, EC_1) + C_L(n) \rightarrow C(AR_1, EC_1)$
09	$C(AR_2) + C_N(n) \rightarrow C(AR_2)$	$C(AR_2, EC_2) + C_L(n) \rightarrow C(AR_2, EC_2)$
0D	$C(AR_1) + C(AR2) \rightarrow C(AR_1)$	$C(AR_1, EC_1) + C(AR_2, EC_2) \rightarrow C(AR_1, EC_1)$
0G	$C(AR_1) + C_S(n) \rightarrow C(AR_1)$	
0H	$C(AR_2) + C_S(n) \rightarrow C(AR_2)$	
0J	$C(AR) + 2^{-39}n \rightarrow C(AR_1)$	
0K	$C(AR_2) + 2^{-39}n \rightarrow C(AR_2)$	

Notes:

1. AR_1 expresses the mantissa part of accumulator 1.
2. AR_2 expresses the mantissa part of accumulator 2.
3. AR_{1-2} is the double precision register connecting the mantissa parts of accumulators 1 and 2.
4. (AR_1), (AR_2), and (AR_{1-2}) are the contents of AR_1, AR_2, and AR_{1-2}, respectively.
5. $(n)_L$ is the long word content of address n and n+1. (n=even)
6. $(n)_N$ is the mantissa part of the above-mentioned long word.
7. $(n)_S$ is the content of address n.
8. EC_1 and EC_2 are the exponet part registers of accumulators 1 and 2, respectively.
9. Address part having 12 bits indicates ten location of short word in the internal memory.
10. Part B indicates one of the six B-boxes, each containing index criterion-register and comparater.

SUMMARY OF CHARACTERISTICS OF TYPE NEAC-1103 PARAMETRON DIGITAL COMPUTER

General characteristics of type NEAC-1103 parametron digital computer are as follows:

(1) Arithmetical operation	Parallel, Floating and fixed binary points	
(2) Address system	One half address system	
(3) Expression of number	Mantissa 40 bits and exponent 8 bits, 48 bits in total Negative number is expressed by 2's complement	
(4) Instruction	Operating parts 8 bits, B-box 4 bits and address 12 bits, 24 bits in total	

(5) Computing speeds

	Floating point	Fixed point
Addition or subtraction	800 μ sec	146 μ sec
Multiplication	900 μ sec	900 μ sec
Division	6 m sec	11 m sec

(6) Number of B boxes	6

(7) Memory system

    7.1 Internal memory: High-speed magnetic core memory system
        (a) Capacity – From 2, 048 to 8, 192 words
        (b) Access time – 25 μ sec
    7.2 External memory: Magnetic drum memory
        (a) Capacity – 10,240 words up to 10 drums
        (b) Magnetic tape capacity – 180,000 words up to 10 sets
    (a) The computer can carry out various arithmetical operations while the transfers between high-speed magnetic cores and drums are in progress.
    (b) Tape units can be operated while computation is in progress.

(8) Input-output Unit

8.1 Photoelectric tape reader	200 ch/sec 2
8.2 Tape perforating typewriter	600 ch/sec 2
8.3 High speed printer	350 ch/sec 2

(9) Power Consumption	Approximately 5 KVA
(10) Necessary floor space	33 square meters