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CENTRAL INTELLIGENCE AGENCY

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COUNTRY USSR

REPORT

SUBJECT Description and Basic Specifications of the Soviet MINSK-2 Digital Computer

DATE DISTR. 8 September 1964

NO. PAGES 1

DATE OF INFO.  
PLACE & DATE ACQ.

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a Soviet brochure entitled General-Purpose Digital Computer "Minsk-2", prepared by V/O MASHPRIBORINTORG, Moscow

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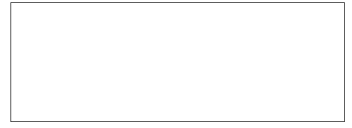
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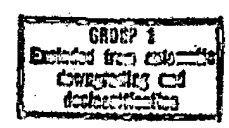
GENERAL-PURPOSE DIGITAL COMPUTER  
"MINSK-2"

V/O "MASHPRIBORINTORG"

USSR

MOSCOW

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### PURPOSE

The digital computer "Minsk-2" is a semi-conductor data processing system. The machine is a general-purpose computer, since it can be used for a wide range of problems arising in business, science and technology. The modular construction of the computer which permits changing its units as desired makes it possible to meet individual requirements of the Users and renders the computer highly suitable for various applications.

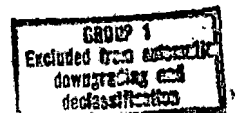
In the business field, the computer can be used for the following purposes:

- calculation of wages and salaries and making of pay-sheets;
- accounting;
- stock-taking;
- production planning;
- compilation of summary specifications;
- optimized transportation planning;
- statistical analysis and solution of other economic problems.

In science and technology, the computer has the following applications:

- matrix operations;
- solution of sets of algebraic equations;
- solution of sets of differential equations;
- calculation of electric and magnetic fields;
- calculation of power networks;
- calculation of transformers, rectifiers and filters;

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study of thermo-nuclear processes in nuclear reactors  
calculation of complex mechanism designs and many others.

Deversified uses of the "Minsk-2" computer are made possible by the following parameters:

sufficiently high computation speed (the average of 5-6 thousand operations per sec.);

large internal storage capacity (4 or 8 thousand numbers);

large external storage capacity (from 400 to 1.6 million numbers);

floating-point and fixed-point operation;

ability to process alphanumeric data;

large set of input and output devices and the possibility of simultaneous operation of the output devices during computation (a programme-interruption mechanism is included in the machine);

excellent programming facilities;

comparatively small dimensions;

high reliability of the system.

**COMPONENTS**

The "Minsk-2" digital computer consists of the following basic components:

central control desk;

photoelectric tape reader;

central computer which incorporates an arithmetic unit and a control unit;

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internal store of the computer (4096 words);  
magnetic tape external store (400 thousand words);  
high-speed digital printer (employs a 70 mm-wide tape);  
2 output paper tape punch units;  
device for punching initial data on a tape;  
document printing unit (a paper roll, 215 mm wide, is used).

SHORT DESCRIPTION OF BASIC COMPONENTS

The central control desk is designed for starting the programme with subsequent control over its execution, manual input of a small amount of data and monitoring computer operation. An important advantage of the control desk which considerably facilitates the operator's task is the indication of the contents of the main registers in the form of octonary numbers and display boards "READY" (ГОТОВНОСТЬ), "OPERATION MODE" (РЕЖИМ РАБОТЫ) and "CAUSE OF STOP" (ПРИЧИНА ОСТАНОВКИ).

The indication and manual control elements are designed and painted so as to decrease operator's fatigue and minimize thereby his operation errors. An important new feature of the computer is also sound indication, as an experienced operator can "follow" the process of programme execution by the noise produced by the machine. Special controls for selected stop of the computer: "INSTRUCTION" (КОМАНДА), "WRITING" (ЗАПИСЬ), "READING" (ЧТЕНИЕ) facilitate programme debugging and reduce the debugging time.

The photoelectric tape reader is intended for input in the computer of instructions and initial information represent-

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ed in the "Minsk-2" digital code and also alphanumeric information in the 2d International Telegraph code. Input of alphanumeric information enhances the efficiency of the computer in solving different problems in the fields of economic planning. Digital information can be read into the machine both in the octonary and decimal codes. Information is read into the computer in blocks which makes it easy to correct or supplement information on the punched tape as desired. The input operation is monitored by automatic calculation of the check sums of the material put into the machine. The input speed is 800 lines per sec.

The central computer consists of a three-register parallel binary arithmetic unit and a central control unit. The arithmetic unit can perform both floating-point and fixed-point operations. The basic time characteristics of the arithmetic unit are as follows:

shift by one digit	- 4 microsec.
fixed-point addition	- 12 microsec.
floating-point addition	- 72 microsec.
fixed-point or floating-point multiplication	- 200 microsec.
fixed-point or floating-point division	- 624 microsec.

Multiplication is performed by the "multiplication by 2 digits" method which greatly reduces multiplication time. If desired, the product can be obtained with a double number of digits. The results may be either rounded-off or not.

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The central control unit coordinates the operation of individual units of the computer and controls the sequence of instruction execution. A special "programme-interruption" unit is provided which makes it possible to print or punch output information without interrupting the computation process - a feature especially important in solving economic planning problems.

The arithmetic unit adder is used as the instruction register of the central control unit which makes the computer more compact. Central control is effected as a definite sequence of synchronous and asynchronous operations.

The synchronous characteristic is helpful for debugging the programme and locating faults in operation; the asynchronous operation makes it possible to reduce the time required for different operations by omitting unnecessary steps when obeying the instruction.

The internal store of the computer is a ferrite-core storage with a capacity of 4096 37-digit binary words. The access time of the ferrite store is 24 microsec. The store is contained in a separate housing, is easily adjusted and highly reliable in operation. Provision is made for connection of another similar store to the computer to bring the total capacity of the internal storage up to 8192 words.

The magnetic tape store is a bay including four pocket-type tape transport mechanisms. The capacity of the entire

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store is 400,000 words. Information on the magnetic tape has special even digits due to which storage and reading of information are monitored automatically. The packing density is 10 pulses per mm. The speed of information exchange with the ferrite store is 2500 words per sec. Both direct - and reverse search of information address is possible which gives a considerable time saving. The information exchange with the internal store is arbitrary: any amount of information from one word to the entire material stored may be exchanged. This feature is extremely useful for programming processing of variable-size groups of information and saves both length of the programmes and the time of their execution. To ensure reliable operation of the magnetic-tape store, each binary digit is written by two magnetic heads, which are switched electronically.

Provision is made for connection of three more magnetic-tape stores to the computer which makes the total capacity of the store 1600 thousand words.

The high-speed printing unit type TBHM-16/1200 is a device whose operation principle is based on continuously-rotating digital wheels. Information may be supplied to the printing unit in the form of octal information, decimal fixed-point information or decimal floating-point information. The contents of one location is printed in one line. The printing speed is 20 lines per sec. With the computer operating in the "motor interlocked", mode, the motor is automatically switched on only when reference is made to the printing unit which decreases the noise level and improves computer reliability.

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Two output tape punch units type ПЛ -20 operate at a speed of 20 lines per sec.

Punch unit No.1 receives both octonary and decimal information as well as information represented in the second International Telegraph Code (alphanumeric information). Punch unit No. 2 can accept only the second International Code. Both punch units can operate simultaneously. From the punch units, the information can be put back into the computer to be typed in a page telegraph printer PTA-50 (teletype) on a paper tape, 215 mm wide, as a final document (invoice, payroll, etc.)

Preparation of initial information in an alphanumeric form is made on a conventional telegraph printer CTA-2M. When numerical information is punched in the machine code for facilitating data preparation the printer CTA-2M with a modified key-board may be used. Both printers may be employed for multiplication of documents by copying them in a repunch unit with a speed of 400 lines per minute.

#### INFORMATION ENCODING

One word of information stored in one location of the "Minsk-2" machine consists of 37 binary digits. The location may contain:

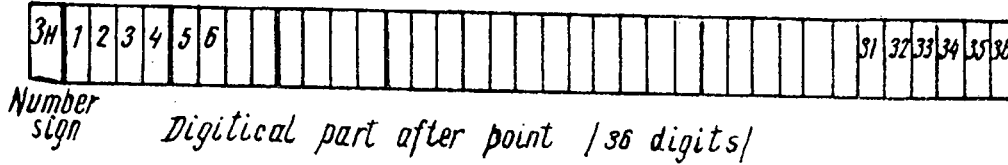
- fixed-point binary number;
- floating-point binary number;
- fixed-point decimal number;
- floating-point decimal number;
- alphanumeric word;
- octonary instruction word.

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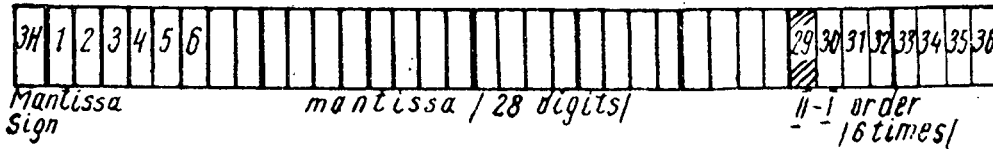
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The binary digit places of the location are numerated as follows: the lefthand digit place is a "Sign digit" and the following digit places bear the numbers from 1 to 36 (from left to right).

A fixed-point binary number is represented in a location as follows:



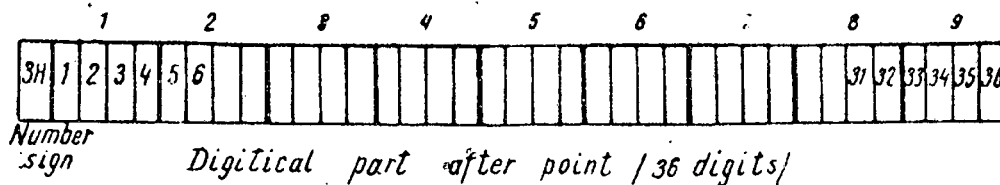
When a location contains a floating-point binary number, binary digits are arranged as follows:



- I - digit sign
- II - unused digit

The digit places of a location storing decimal numbers are shown in the following two figures:

Fixed-point decimal number

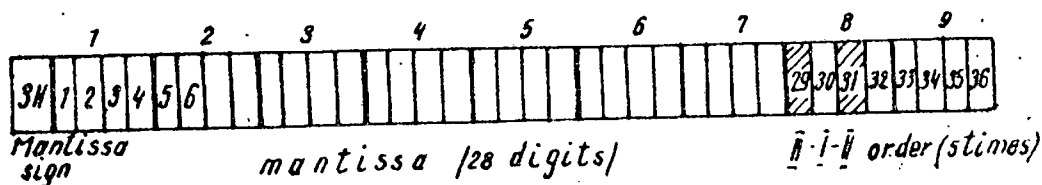


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## Floating-point decimal number



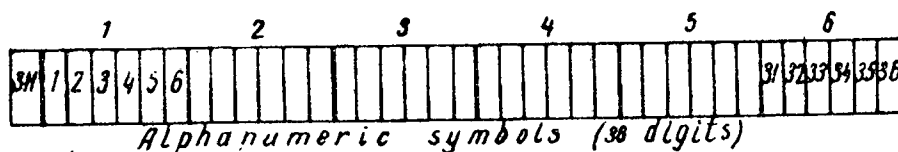
I - digit sign

II - unused digits

The range of floating-point decimal numbers is the following:

0.5421010.10<sup>-19</sup>0.9223372.10<sup>+19</sup>

The next figure shows the arrangement of alphanumeric information in a location, each information symbol being coded in 6 binary digits:



## PROGRAMMING

All operations performed by the "Minsk-2" machine include the following basic groups of operations:

arithmetical operations;

logical operations;

transfer operations;

auxiliary operation;

control operations;

reference to external storage;

input-output operations;

special arithmetical operations.

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The computer uses two-address instructions. An instruction occupies one full storage word. Besides the addresses of two operands, the instruction code also contains a short address (four binary digits) of the index location. The index locations serve for automatic modification of instruction addresses and for counting the number of cycle repetitions which greatly simplifies programming, decreases the length of programmes and considerably reduces the time of programme execution. The first 15 locations of the internal store are used as index locations.

The typical structure of a standard instruction is as follows:



- $K$  011 - operation code
- $N$  - block number
- $l$  - index-address
- $a_1$  - first address
- $a_2$  - second address

Each arithmetical and logical operation has four modifications. This makes the two-address instruction system highly flexible and imparts to it the advantages of both the single address system (information can be accumulated without placing the results in the storage) and the three-address instruction system (three operands are available for operation: adder, first address and second address).

The system of computer instructions covers a wide range of control instructions - conditional and unconditional tran-

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sfers - which is particularly helpful for programming processes with different characteristics.

The system of instructions includes special instructions for programme control of programme interruption. The interruption system allows to execute several programmes simultaneously, making transfers from one programme to another when special signals appear. Thus, computation operations may easily be combined with the output of a large amount of information and, thereby, the machine dead time due to slowly-operating output devices is reduced to zero.

The logical principle is employed in the octal numeration of the codes, therefore, operation encoding does not require much time or special efforts on the part of programmers.

The machine is provided with a library of standard subroutines and routines for automation of small programming operations which greatly saves programming time and makes redundant a large part of the User's mathematical personnel. The computer is also provided with the programmes of standard economic problems arising at plants and factories.

#### CONSTRUCTIONAL FEATURES

The computer "Minsk-2" has a modular construction, each unit being mounted in an individual standard bay or a transportable rack and fitted with an individual control and monitoring panels. On the "Minsk-2" computer, it is possible to independently check the central computer, the magnetic-tape store unit and printing and punch units simultaneously.

The machine cells are intercoupled by printed connectors and employ printed circuits throughout. The computer "Minsk-2"

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has 23 types of cells. A special stand is delivered with the computer for checking and adjusting computer cells.

Constructionally, the computer consists of 4 standard bays with dimensions of 1100x650x1800 mm, a tape-transport mechanism bay, 1640x650x1800 mm, a control panel, 1350x950x1150 mm, and two racks housing input and output devices with the dimensions of 900x650x1000 mm. The floor space required for normal operation of the computer is 40-50 sq.m.

The machine requires no special equipment, except a power supply panel and, if necessary, an exhaust fan.

## BASIC SPECIFICATIONS

Operation speed	5-6 thousand operations/sec
Ferrite-core store capacity (M03Y)	4096 words
Ferrite store access time	24 microsec
Magnetic-tape store capacity (HMM)	400,000 words
Speed of information exchange with external magnetic-tape store	2500 words/sec
Number representation	floating-point and fixed-point
Number of digits	37 binary digits (sign included)
Range of fixed-point number representation	
Range of floating-point number representation	$10^{-29}$ $10^{+19}$
Instruction code	two-address
Number of instructions	101
Speed of information reading out from punched tape	800 lines/sec

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Speed of information reading

into high-speed printing unit

BPM -20

20 words/sec

Speed of information reading into  
punch unit

20 lines/sec

Type of input and output informa-  
tion

decimal, octal, alpha-  
numeric

Operation calculus system

binary

Floor space requirements

40-50 sq.m

Power consumption

about 4 kVA

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