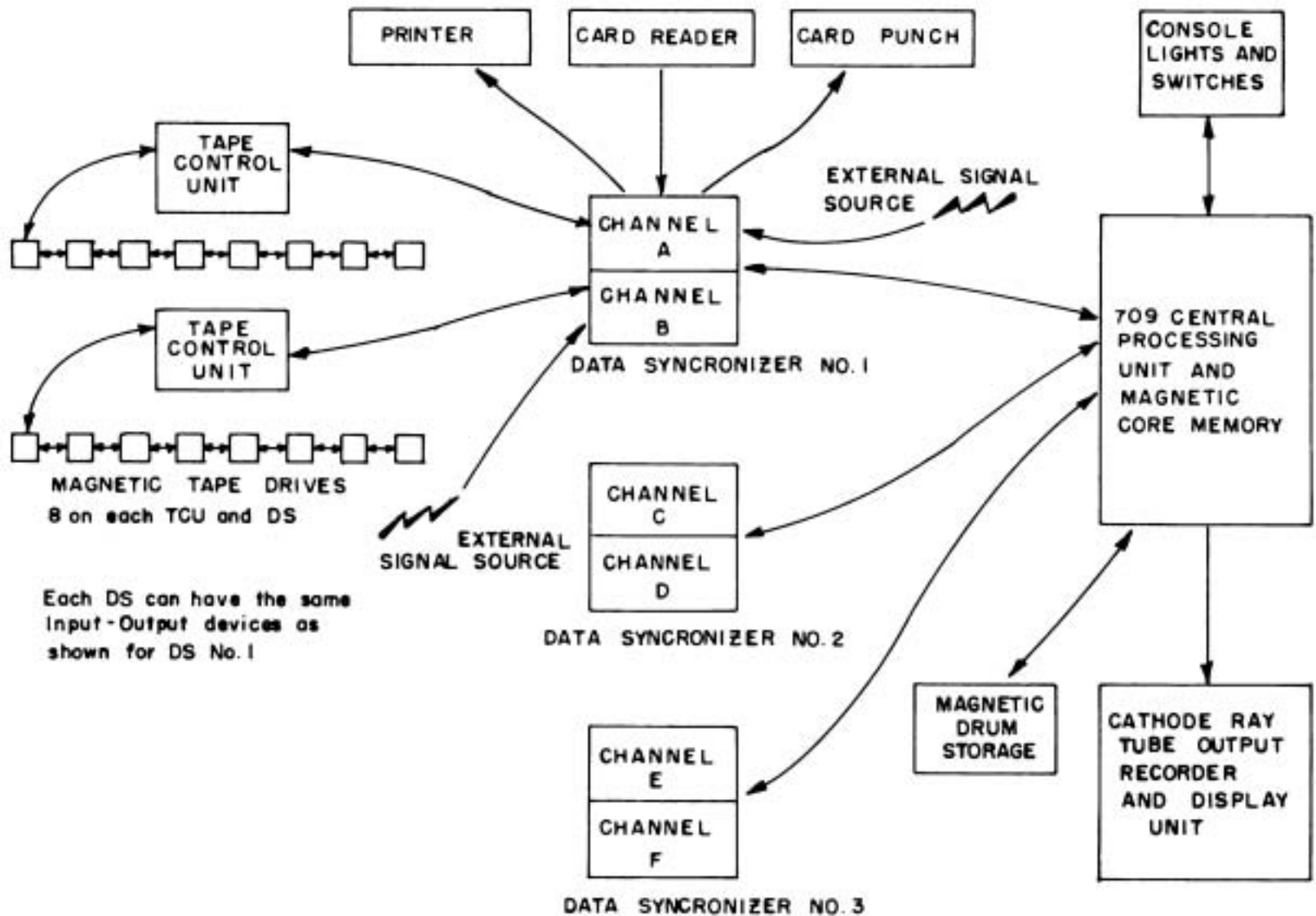


# IBM 709

## MANUFACTURER

International Business Machines Type 709 Electronic  
Data Processing System (Advance Description)

International Business Machines Corporation



SCHEMATIC SHOWING DATA FLOW FOR INPUT-OUTPUT FOR IBM 709 DATA PROCESSING SYSTEM

Picture by International Business Machines Corporation

### APPLICATIONS

Engineering development, scientific research, production scheduling and control, logistics, procurement and supply and other areas.

### NUMERICAL SYSTEM

Internal number system	Alphanumeric or bin coded dec
Binary digits per arithmetic word	35 plus sign
Binary digits per logical word	36
Binary digits per instruction word	36
Characters per word	6
Binary digits per character	6
Instructions decoded	189
Instructions used	189
Arithmetic system	Fixed and floating point.
	Logical operation
Instruction type	One address

### ARITHMETIC UNIT

#### Fixed Point Operation

	Microsec
Add time (includ. stor. access)	24
Instructions require integral multiples of 12 microseconds, which is the machine cycle time.	
Mult time (includ. stor. access)	72 - 240
Div time (includ. stor. access)	240
Logical operation	24

#### Floating Point Operation

	Microsec
Add time (includ. stor. access)	84
Mult time (includ. stor. access)	204
Div time (includ. stor. access)	216

#### Arithmetic mode

#### Timing

Parallel  
Synchronous for Central Processing Unit

Operation Asynchronous for Input-Output Devices  
Magnetic tape reading, magnetic tape writing, card reading, card punching, and line printing are concurrent with internal processing.

## STORAGE

Media	Words
Magnetic Core (IBM 737 and 738)	32,768 or 8,192, or 4,096
Magnetic Drum (IBM 733)	16,384 or 8,192

Characters may be letters of the alphabet, decimal numbers, or any of eleven punctuation marks or symbols. If only numerical information is being processed, storage takes place in the binary number system. Thus, 327,680 decimal digits can be stored in the magnetic core storage unit. Storage units of 4,096 or 8,192 core storage registers are available. Up to 8 magnetic tape drives may be associated with each Tape Control Unit. Two Tape Control Units may be associated with each Data Synchronizer. Up to 3 Data Synchronizers may be utilized.

## INPUT

Media	Speed
Card Reader (IBM 711 Mod. 2)	250 cards/min
Magnetic Tape (IBM 729 Mod. 1)	90,000 bin dig/sec

Magnetic tape speed is 75 in/sec at 200 char/in (1,200 bin dig/lineal inch). This totals 15,000 char/sec when operating in the binary coded decimal mode and the equivalent of 25,000 decimal digits/sec when operating in the binary mode. Rewind rate is 400 inches/sec average for 2,400 ft tapes. Variable length records and files may be made.

## OUTPUT

Card Punch (IBM 721)	100 cards/min
Magnetic Tape	Same as above
Printer (IBM 716)	150 lines/min 120 alphanumeric char/line
CRT Recorder (IBM 740)	8,000 plotted points/sec 7-in tube for photo recording
CRT Display	21-in tube for visual display

## CHECKING FEATURES

### Magnetic Tape:

The double-gap read-write head offers immediate verification of tape when writing. A tape that is being written passes first over the writing gap, and then over the reading gap. Information that has been written is automatically read and both the vertical check for each character and the longitudinal check for each record is performed. If the record was incorrectly written, it will be detected and the check indicator will be turned on. Background noise and information signal levels are checked and must be at acceptable levels.

### Line Printer:

Echo checking for each printed number.

### Card-to-Tape:

Horizontal and vertical redundancy check on tape. Comparison of card information read at two stations.

Tape-to-Card:  
Same as card-to-tape checking. Independent verification of the validity of written tapes.  
Accumulator overflow check  
Divide check  
Floating point underflow and overflow check.

## PRODUCTION RECORD

The information contained in this system description is preliminary to delivery of Type 709 Systems.

## ADDITIONAL FEATURES AND REMARKS

### Operating Features

#### Indirect addressing

Variable length multiplication and division. It is possible for the programmer to specify the number of bits in the multiplier or the number of bits that he wishes to have developed in the quotient. Unnecessary machine steps can be eliminated and considerable time saved.

#### High-speed conversion operations

Automatic detection of overflow and underflow in floating point arithmetic through a new trapping mode. In floating point operations, it is possible to develop a number which is either too large or too small to be represented in the range of numbers that can be accommodated by the floating point scheme used in this machine. These limits are approximately  $10^{38}$  and  $10^{-38}$ . These conditions are called overflow and underflow, respectively. When these occur during the execution of a floating point instruction, the contents of the address part of location zero are replaced by the location of the floating point instruction plus one. The machine takes its next instruction from location 2 and proceeds from there.

Interruption of processing by trapping as a result of an external signal.

Increased flexibility in using the three index registers that are provided.

Ability to perform interpreted or pseudo-operations at any point within a program.

A total of 104 new operations have been added to those of the 704. (Two have been replaced by more powerful operations so that the total number of operations in the 709 is 189.)

Convert instructions are included. For example, a simple program of three instructions can be used to replace leading zeros in a six-digit binary coded decimal numerical field by blanks. This program takes 144 microseconds to execute.

Zero skipping on multiplication. On all multiplication operations, including floating point multiplication, a zero product is created in 24 microseconds, if the multiplicand is all zeros. If a zero bit is encountered in the multiplier, the next digit is immediately examined. Multiply time will vary from 72 to 240 microseconds, depending on the number and distribution of zeros in the multiplier.

Adaptable to both commercial and scientific applications

#### Independent input-output control

#### Variable length input and output records

Special instructions for number system conversion, e.g., binary to decimal, decimal to binary

#### Full array of logical operations

Special instruction for facilitating compiling and interpreting

#### Indirect addressing

#### Facilities for real-time operations

#### 36 internal sense indicators.

Peripheral Operations:

Card-to-Tape - 250 cards per minute  
Tape-to-Card - 100 cards per minute  
Tape-to-Printer - 150 lines per minute, 120 characters per line, or 500 lines per minute, 120 characters per line

The above peripheral equipment utilizes the IBM 727 Magnetic Tape Unit.

Data Synchronizer:

Features

Simultaneous operation of any combination of input and output functions and computing. Real-time facilities

Capacity

Up to 3 units may be used  
2 input-output channels per unit  
Maximum of 6 channels for simultaneous functions

Punched Card Input-Output

Up to 3 IBM 711 Card Readers  
Up to 3 IBM 721 Card Punches

Line Printed Output

Up to 3 IBM 716 Printers  
Magnetic Tape Input-Output  
Up to 48 IBM 729 Magnetic Tape Units

Index Registers

Capacity

Three 15-bit registers

Advantages

Provide automatic address modification  
Reduce programming time  
Reduce length of program  
Reduce storage requirements for instructions

Other Features:

IBM 774 Tape Data Selector

Independent storage and control unit enabling the rearrangement or direct transmission of data from a 727 Magnetic Tape Unit to any one of four output units: the 402, 403, or 407 Accounting Machine, or the 519 Document Originating Machine.

Magnetic Tape Computability with:

650 Data Processing System  
701, 702, 704 and 705 Data Processing Systems  
704 Program Computability  
Programs written for a 704 with Floating Point Trap may be run on the 709 without alteration except for changes in input-output routines

FORTRAN (Automatic Formula Translation)

Advanced program for automatic translation of mathematical notation to efficient IBM 704 programs. The same logical concepts in FORTRAN may be used to construct a similar program translator for the 709.

IBM Service

Executive and Programming Schools  
Applied Science Representatives in local IBM offices  
Special Representatives in specific industries  
Trained electronics maintenance engineers

## COST, PRICE AND RENTAL RATE

### RENTAL RATES FOR THE TYPE 709 SYSTEM

<u>TYPE</u>	<u>DESCRIPTION</u>	<u>MODEL</u>	<u>MONTHLY CHARGE</u>
709	Central Processing Unit	1	\$10,000
736	Power Supply	2	1,100
741	Power Supply	2	1,400
741	Power Supply	3	1,600
746	Power Distribution Unit	2	1,300
746	Power Distribution Unit	3	1,300
711	Card Reader	2	800
716	Printer	1	1,200
721	Card Punch	1	600
729	Magnetic Tape Unit	1	650
755	Magnetic Tape Control	1	1,800
733	Magnetic Drum Storage	1	3,100 (8,192 words)
733	Magnetic Drum Storage	2	3,500 (Each additional 8,192 words)
737	Magnetic Core Storage	3	4,000 (4,096 words)
737	Magnetic Core Storage	4	3,200 (Each additional 4,096 words)
738	Magnetic Core Storage	1	20,000 (32,768 words)
740	CRT Recorder	1	2,700
780	CRT Display	1	150
766	Data Synchronizer	1	3,500
766	Data Synchronizer	2	3,500

Rental rates are subject to change.

Tape-to-card and card-to-tape conversion equipment is available as for other International Business Machines' Electronic Data Processing Systems.

The IBM Type 709 System consists of several separate units under the control of the Central Processing Unit. A minimum system includes the types 709, 736, 741, 746, 737, 711, 716 and 766 units. The capacity of the system is flexible and may be expanded by the addition of storage and input-output units. All operations of the IBM 709 are controlled by a stored program of the single-address type. The system utilizes a set of instructions which provides flexibility by programming.