

**UNIVAC<sup>®</sup> 1107**

TECHNICAL BULLETIN

***UNIVAC 1107***

***Input-Output Instructions***

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# 1. CENTRAL COMPUTER INPUT-OUTPUT

The input-output section of the Central Computer in the UNIVAC® 1107 Data-Processing System contains the control circuits necessary for direct communication between the Computer and Peripheral Subsystems.

## INPUT-OUTPUT CHANNELS

Communication between the Computer and peripheral units is scheduled over sixteen input-output channels. Each channel contains two cables, one for input and one for output operations. To provide for parallel reading and writing of the 36 bits in the basic UNIVAC 1107 word, each cable contains 36 data lines. Each cable also contains various control lines which are used for transmitting control signals. The two cables for each channel enable the system to accommodate bidirectional transfers of information and control signals between the Computer and the peripheral devices.

Standard peripheral subsystems utilize both the input lines and the corresponding output lines of the same channel. Data transfers on these units

(UNISERVO\* IIA Magnetic Tape Units, Punched Card Units, High-Speed Printers, and so on) are bidirectional, but they do not occur at the same time; that is, data flows in only one direction over a single channel during any given interval.

When all sixteen input-output channels are operating concurrently, word transfers are multiplexed to provide an instantaneous communication rate of 250,000 words (1,500,000 characters) per second. In respect to efficiency, the number of channels in concurrent operation is contingent upon the transfer rates of the peripheral equipment in use. Faster rates of transfer tend to reduce the number of channels operating concurrently.

The sixteen input-output channels are numbered 0 through 15. Normally, channel number 15 is reserved for the Control Console. Assignments for the remaining fifteen channels will vary between installations. As a general rule, however, peripheral units with high rates of transfer are associated with lower-numbered channels. (See Priority Control Network, page 1-2.)

\* *Trademark of Sperry Rand Corporation.*

## COMMUNICATION MODES

Each channel is capable of operating in three different communication modes: input, output, or function. As their names denote, the input and output modes are employed when transferring data to or from the Computer. The function mode is the means by which the Central Computer establishes the initial communication path with a Peripheral Subsystem. In this mode of transmission, the Computer sends one or more Function Words to a Peripheral Subsystem. These words direct the units to perform the desired operation.

## ACCESS-CONTROL REGISTERS

Regardless of the communication mode, the actual word-by-word transmission over a given channel is governed by access-control registers in magnetic-film memory. Two such registers, one input and one output, are assigned to each of the sixteen channels. The input registers are located at addresses 40 through 57 (octal). Address 40 corresponds to channel number 0, 41 to channel 1...57 to channel number 15. Output access-control registers utilize film addresses 60 through 77, with lower-order address corresponding to lower-number-channels.

Input access-control registers govern the transmission of input data words. The output access-control registers govern the transmission of *both* output data words and function words.

Associated with these registers is an input-output access-control word. As shown in Figure 1-1, this word consists of three sections: *G* is the increment designator; *W* is the number of words to be transferred; and, *V* is the initial core storage address to or from which data will be transferred.

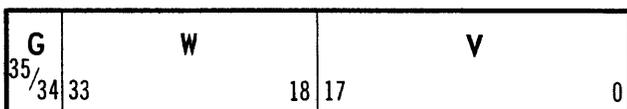


Figure 1-1. Input-Output Access-Control Word Format

In initiating a communication mode, the appropriate access-control word is sent to the access-control register corresponding to the channel servicing the specified peripheral equipment. The *V* portion of this word contains the address to or from which the first word will be transferred. After each word

is transferred, *W* is decremented and tested against zero. Equality with zero terminates the transfer operation, while inequality causes the transfer of the next word in the data block.

Depending upon the contents of *G*, subsequent words will be transferred to or from an initial core storage address (*V*) that will: ascend in value (*V* + 1); descend in value (*V* - 1); or retain the same value (*V*). The bit configurations in *G*, along with the operations they specify, are as follows:

<b>G</b>	<b>OPERATION</b>	<b>NEXT ADDRESS</b>
00	Increment <i>V</i> Address	<i>V</i> + 1
01	Inhibit Increment	<i>V</i>
10	Decrement <i>V</i> Address	<i>V</i> - 1
11	Inhibit Decrement	<i>V</i>

The ability to reference the same address for successive word transfers is an unusual feature and is extremely useful in the following processing situation. If a given peripheral unit has a communication rate much slower than that of the Central Computer, and the main program is synchronized with the transfer rate of the peripheral device, successive input words can be processed in real-time using a single address in memory.

## PRIORITY CONTROL NETWORK

Although all sixteen channels can be alerted for communications between the Computer and peripheral units at the same time, only one channel will actually be communicating with the Computer during a given interval.

To accommodate concurrent communications, channel operations are sequenced and synchronized by a priority control network within the input-output section of the Central Computer. Priority-control circuits, working in conjunction with access-control circuits, resolve situations where two or more channels simultaneously attempt to communicate with the Computer. In these cases, access to the Computer is granted on the basis of the following priority schedule:

1. Real-time clock incrementation.
2. *An Input Data Request:* unless currently processing an input data request, in which case an output data request will take precedence.

3. *Output Data Request.*
4. External synchronization interrupt.
5. Real-time clock overflow interrupt.
6. *External Interrupt.*
7. Function monitor interrupt.
8. Input monitor interrupt: unless currently processing an input monitor interrupt, in which case an output monitor interrupt will take precedence.
9. Output monitor interrupt.

When two or more channels simultaneously request the Computer to process operations occupying *the same priority level* access is granted to the lowest-numbered channel.

When both an input and an output data request are present (items 2 and 3 on the schedule), priority will alternate. For example, if the input data request

had arisen first, priority would be granted in the following manner: process one input data word, alternate and process one output word, alternate and process one input word, and so on.

If, during the alternating of input-output data requests, a real-time clock incrementation occurs (an operation of higher priority) priority would still alternate, but the pattern would differ: process one input, alternate but process the real-time clock incrementation, alternate and process one input, alternate and process one output, alternate and process one input, and so on.

Simultaneous input and output monitor interrupts (items 9 and 10 on the schedule) are handled in a manner similar to that employed for simultaneous input and output data requests. An operation of higher priority, occurring while the processing of monitor interrupts are being alternated, will replace the next scheduled operation and then alternate to the opposite of that which was replaced. This procedure is identical to incrementation of the real-time clock while alternating input and output data requests.

## 2. PERIPHERAL CONTROL

The input-output section of the Central Computer in the UNIVAC 1107 Data-Processing System can accommodate a wide range of peripheral subsystems. Some of these units can be used to provide a hierarchy of auxiliary storage. Included in this category are magnetic drum and magnetic tape devices. Other equipment can serve as input or output devices. Card units, printers, and document-sensing devices typify the equipment within this classification. A third category of peripheral equipment provides information links to other systems. In addition to these standard peripheral subsystems, the Central Computer can also communicate with many real-time input-output devices, such as the Uniset\* and Unisaver\*.

A standard peripheral subsystem — whether it be card, tape, or drum — consists of one or more units of the same type, a Control Unit for the particular type of equipment, and a Channel Synchronizer.

\* *Trademark of Sperry Rand Corporation.*

### CHANNEL SYNCHRONIZER

The Channel Synchronizer, housed with the peripheral Control Unit in a single cabinet, provides the proper interface between the Computer and peripheral equipment. The Channel Synchronizer accepts 36-bit words from the Computer and sends 6-bit character elements to the peripheral Control Unit. This unit, in turn, will direct the individual output devices to perform the desired operation.

Because communication is bidirectional, the Channel Synchronizer also assembles 6-bit characters from the Control Unit and sends 36-bit words to the Computer.

Other control functions of the Channel Synchronizer include: primary interpreting of the function words; searching by comparison of an identifier

with data read from a peripheral unit, and providing the Computer with peripheral unit status information.

## COMMUNICATION PATHS

Two cables connect each peripheral subsystem to the Computer. The cable employed during input operations contains 36 data lines and 5 control lines. The second cable, the one used for output operations, consists of 36 data lines and 4 control lines. Figures 2-1 depicts the cables that constitute an input-output channel.

Four types of words are transmitted on the data lines connecting the Computer to the peripheral subsystem:

- *Data Words*
- *Function Words*
- *Identifier Words*
- *Status Words*

## Data Words

In respect to peripheral equipment, a data word consists of six 6-bit characters. The contents of bit positions 35 through 30 is the most significant character, while the contents of bit positions 5 through 0 constitute the least significant character.

In transmitting data to the Computer, an Input Data Request signal is generated, signifying that a data word is on the 36 data lines. After the Computer has accepted the data word, it generates an Input Acknowledge signal.

During output operations, the peripheral Control Unit generates an Output Data Request signal which informs the Computer of the unit's availability. After placing the output data word on the data lines, the Computer generates an Output Acknowledge, telling the peripheral Control Unit that the 36 lines hold a data word. Upon accepting this word, the peripheral Control Unit will regenerate the Output Data Request signal.

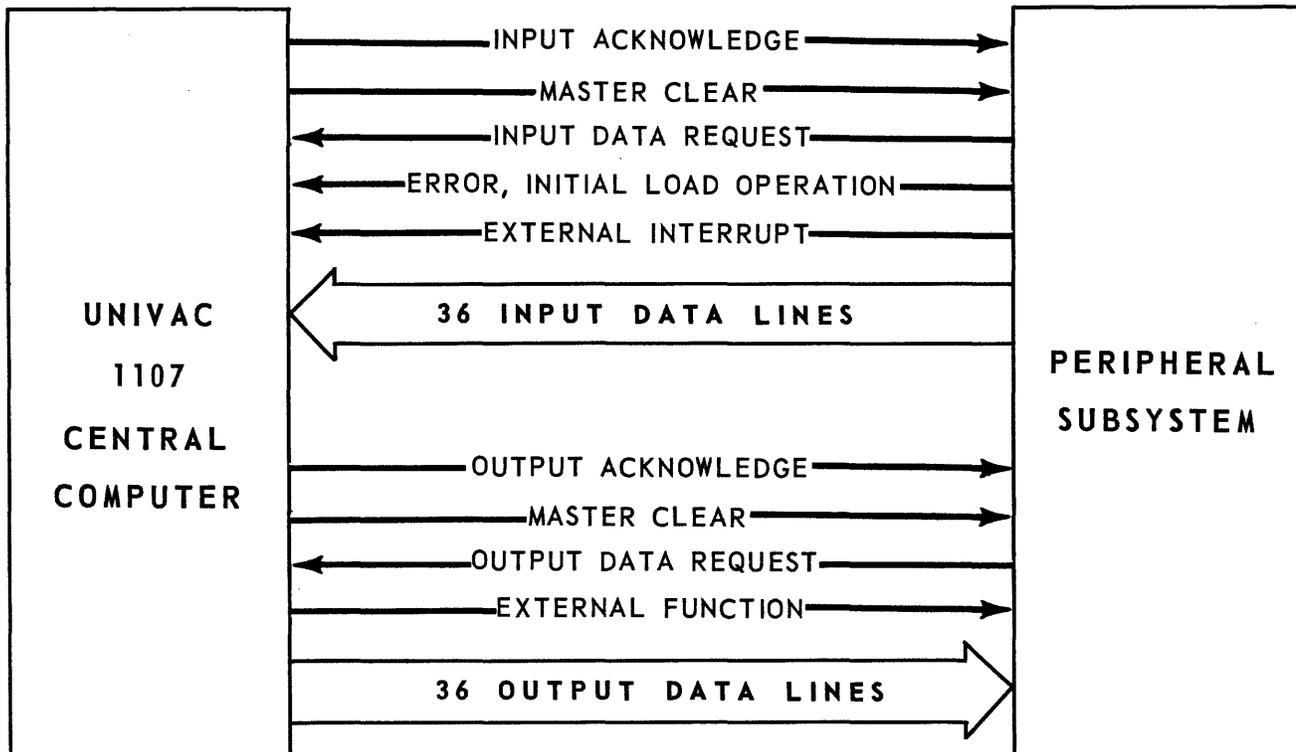


Figure 2-1. UNIVAC 1107 Input-Output Channel

## Function Words

The function word contains the operating instructions for the peripheral units. Like the data word, a function word consists of six 6-bit characters.

The Channel Synchronizer, upon receiving a function word, interprets the function code contained in bit positions 35 through 30. This code sets the operating mode for the Channel Synchronizer and subsystem units.

In the Magnetic Tape, Paper Tape, and Punched-Card Subsystems, bit positions 11 through 0 are used to select a specific unit within the subsystem. Any

one of up to 12 units can be selected in a typical Magnetic Tape Subsystem, two in a High-Speed Printer Subsystem, one in a Punched-Card Subsystem, and four in a Paper Tape Subsystem.

Bit positions 22 through 0 are used for unit selection, as well as specification of a given address on the selected unit, in the Magnetic Drum Subsystem. Positions 23 through 18 in the function word specify the line-spacing instruction (64 possibilities) for the High-Speed Printer and the format-level instructions (6-bit or 8-bit character transmission) for the Paper Tape Subsystem.

The bit position designators of the function word for the various subsystems are shown in Figure 2-2.

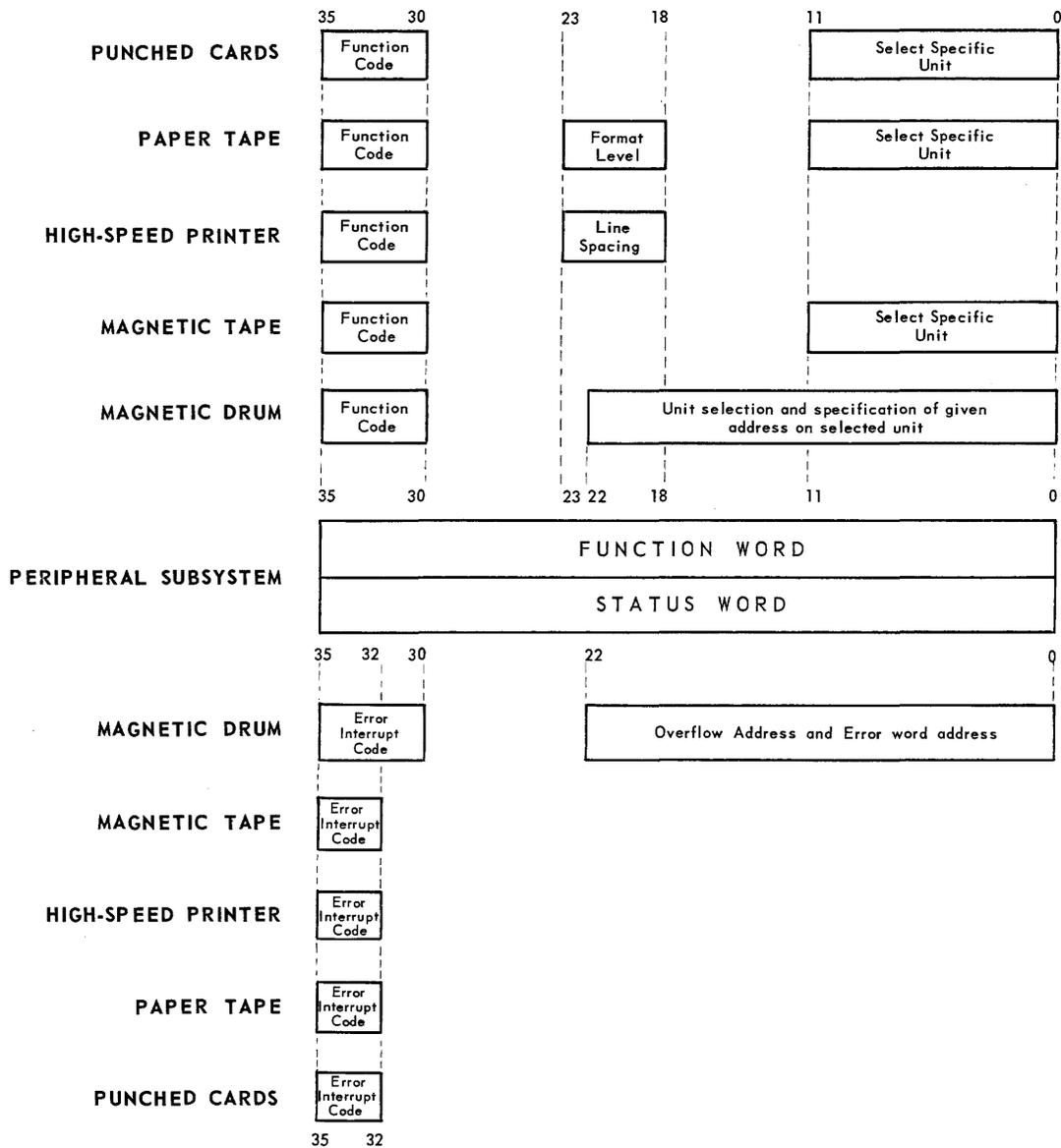


Figure 2-2. Function Word and Status Word Bit Position Designators

A function word is sent from the Computer to the Peripheral Subsystem in the same manner as output data words. To distinguish between the two, the Computer generates an External Function signal after placing the function word on the 36 data lines.

This signal is transmitted over the external function control line. Upon receiving the signal, the Peripheral Subsystem is alerted to receive a function word. After accepting this word, the Peripheral Subsystem generates either an Output (or an Input) Data Request signal, signifying it is ready to accept (or transmit, in the case of an Input Data Request) another word from the Computer.

### **Identifier Words**

The identifier word is a full-length computer word which immediately follows a Search or a Search-Read Function Word.

Like a Function Word, the identifier word is first placed on the data lines after which an External Function signal is generated by the Computer and transmitted via the external function control line to the subsystem. The identifier word is then stored in a special register in the Channel Synchronizer and compared character-by-character with each word read by the peripheral unit.

### **Status Words**

Composed of six 6-bit characters, the status word stores any error information which may be generat-

ed by the peripheral Control Unit and the Channel Synchronizer. Like the function and identifier words, the status word is transmitted over the 36 data lines and the accompanying external function signal is sent over the external function control line. Figure 2-2 shows the function and status word bit position designators.

Bit positions 35 through 30 of the status word contain the error information (status code). Positions 35 through 32 are normally referred to as the Interrupt Code. With the exception of the Magnetic Drum Subsystem which uses the entire first character of the status word, the error information is stored in these upper four bit positions.

The Magnetic Drum Subsystem is the only Peripheral Subsystem that uses bit positions 22 through 0 in the status word. These positions contain the overflow address and the error word address. The error is thus pinpointed at a specific address on a specific drum.

The entire status word is always transferred to the Central Computer despite the fact that the Magnetic Drum Subsystem is the only Peripheral Subsystem utilizing more than the most significant character in the word. The status word is sent to the Computer in the same manner as an input data word with the exception that an External Interrupt signal is generated after the Channel Synchronizer has placed the word on the input data lines. In this manner, the Central Computer can distinguish status words from normal input data words.

## 3. INPUT-OUTPUT OPERATIONS

The computer program initiates all input-output operations which involve the activities of Peripheral Subsystem Units. Eighteen instructions in the UNIVAC 1107 repertoire are used for controlling input-output operations. These instructions prescribe the three major modes of operation within the input-output control section of the Computer: Input Data Transfer, Output Data Transfer, and Function Transfer.

### CONTROL SIGNALS

To provide for the orderly transmission and reception of data and function words between the Computer and the subsystems, various control signals are used to control the flow of data and function words. These control signals travel over the control lines of the input-output channel (see Figure 2-1). A listing of these control signals, and their respective functions, is provided in Table 1.

### THE INTERRUPT

One of the more important control signals governing the input-output operations of the Computer and the subsystem is called the interrupt. This special signal is used to demand the immediate attention of the Computer. It causes program control to be switched to a special subroutine connected with the event or circumstances initiating the interrupt. Interrupts from external sources serve primarily to synchronize the computer program with the status of subsystem units, and this includes the indicating of error conditions occurring within the peripheral subsystems. Internal interrupts synchronize the computer program with the termination of input-output transfers.

### MONITORED INSTRUCTIONS

As indicated in the input-output instruction repertoire, instructions calling for input, output, or function transfers may be executed in one of two ways: with or without a monitor. With a monitor means that an internal interrupt will be generated automatically, upon completion of the transfer. When the transfer is made without monitor, that means automatic interrupt is inhibited.

In general, whether an instruction is programmed with or without a monitor is a determination that is made by the programmer. In some cases, however, the use of the monitor may be dictated by the particular operation. For example, since function transfers are essentially output transfers, output access control words must control both output data and function transfers. Therefore, when programming output operations, the Initiate Monitored Function Mode instruction must be programmed. Upon completion of the function transfer, the monitor interrupt will direct program control to the execution of an Initiate Output Mode transfer instruction.

### INPUT-SECTION SECTION

The activities of the Computer's input-output section are directed by the stored program of instructions. The program initiates a particular operation on an input-output channel by means of an Initiate Input Mode, Initiate Output Mode, or Initiate Function Mode instruction (with or without monitor). These instructions activate the particular mode on the channel and store the appropriate access control word (see Access-Control Registers, page 1-2.) necessary for controlling the word-by-word transfer of information to or from the Computer.

SIGNAL	ORIGIN	MEANING	EFFECT
Output Data Request	Output Unit	Output Unit is ready to receive next output word.	Computer forms next output word and sends output acknowledge.
Output Acknowledge	Computer	Computer has transmitted next output word.	Initiates cycle whereby output unit accepts and processes output word.
Input Data Request	Input Unit	Input Unit is ready to transmit next input word.	Computer accepts input word and sends input acknowledge.
Input Acknowledge	Computer	Computer has received last input word.	Initiates cycle whereby input unit produces next input word.
Interrupt	Peripheral Unit	Peripheral Unit requires output from (or input to) Computer.	Causes program to jump to interrupt subroutine for that channel.
External Function	Computer	Word on data lines is an external function word.	Peripheral control unit decodes function word.
Master Clear	Computer	Master Clear Control on the Control Console was depressed.	Operator wishes to clear all computer registers including those in the Input-Output Section.
Error on Initial Load	Peripheral Unit	Indicates an error occurred during Initial Load Operation.	Initial Load fault light on Control Console lights, operator may reinstate Initial Load operation.

NOTE: The terms "output" and "input" are referenced with respect to the Computer; that is, input is to the Computer and output is from the Computer.

Table 1. Input-Output Control Signals

Each of the 16 input-output channels is programmed separately. After an operation on a particular channel is initiated, the channel operates automatically, independent of the main computer program, until the operation is completed or terminated.

### INPUT-OUTPUT INSTRUCTION REPERTOIRE

Eighteen instructions in the UNIVAC 1107 repertoire are devoted to input-output operations. The format of these instructions is identical to that of instructions stipulating internal operations. As shown in Figure 3-1, the basic instruction word consists of seven designators, with each designator represented by a letter.

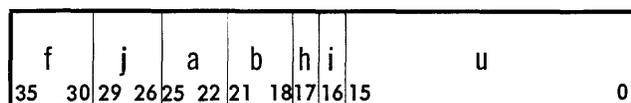


Figure 3-1. Input-Output Instruction Word

In the execution of an input-output instruction, the *f* and *j* designators combine to form a ten-bit operation code. Note that the *j* designator in these instructions does not serve as a partial word determinant as it does with many of the internal instructions.

The *a* designator specifies the input-output channel pertinent to the operation. Because an input and an output access-control register is associated with each channel, the *a* designator effectively specifies the film-memory address to which the input-output access-control word is to be transferred.

The instruction's *b*, *h*, and *i* designators stipulate index-register modification, incrementation of the modifier, and indirect addressing. The *u* designator specifies an address in magnetic-film or core memory. This address will contain either a control word to be loaded into the specified access-control register or the instruction that will be executed in the event a jump condition is met.

The 18 input-output instructions are treated individually in the following pages. The mnemonic and octal representation of the operation code is shown for each instruction. Additional information pertinent to the programming of a given instruction is contained in the notes following that instruction. Execution times are in microseconds.

### INITIATE INPUT MODE

OPERATION CODE: 75

MNEMONIC CODE: IIPM

MINOR OPERATION CODE:  $j = 00$

DESCRIPTION: Transfer the contents of the *U* address to the appropriate input access-control register and initiate the input mode on the channel specified by the *a* designator.

NOTES: The 4-bit contents of the *a* designator effectively specify one of sixteen input access-control registers, addresses 40 through 57 (octal) in magnetic-film control memory.

When programming an input operation, this instruction must be executed before the Initiate Function Mode instruction. The alternative would result in the peripheral subsystem, without access to the input lines, receiving a Function Word specifying the reading of data into the Computer.

The actual input transfer will not begin until the peripheral subsystem has generated an Input Data Request signal. This signal will not arise until the peripheral unit has been informed of the operation, via the Function Word, and placed the first data word on the input lines.

EXECUTION TIMES: Alternate Banks 4.0  
Same Bank 8.0

### INITIATE MONITORED INPUT MODE

OPERATION CODE: 75

MNEMONIC CODE: IMIM

MINOR OPERATION CODE  $j = 01$

DESCRIPTION: Transfer the contents of *U* to the specified input access-control register and initiate the input mode on the corresponding channel. Upon completion of the input transfer, an interrupt will occur.

NOTES: See notes covering Initiate Input Mode instruction.

EXECUTION TIMES: Alternate Banks 4.0  
Same Bank 8.0

## INPUT MODE JUMP

OPERATION CODE: 75  
MNEMONIC CODE: IMJP  
MINOR OPERATION CODE:  $j = 02$

DESCRIPTION: If the input channel is in the input mode, jump to  $U$ ; if not, take the next sequential instruction.

NOTES: The contents of the  $a$  designator specify the channel to be tested.

If  $U$  specifies an address below 200 (octal) and the jump condition is met, the next instruction will come from the specified address in core memory.

This instruction will only test to see if the input mode is activated. It will not reveal whether data is currently being transferred.

EXECUTION TIMES:   Jump       4.0  
                      No Jump   4.0

## TERMINATE INPUT MODE

OPERATION CODE: 75  
MNEMONIC CODE: TIPM  
MINOR OPERATION CODE:  $j = 03$

DESCRIPTION: Terminate the input mode on the specified channel.

NOTES: This instruction de-activates the input mode. Because this is an internal termination, errors or faults could be generated by the peripheral subsystem. For example, less than six characters may have been transferred to the peripheral Control Unit, in which case a character count error will occur.

The contents of the input access-control register are not altered by this instruction.

EXECUTION TIME: 4.0

## INITIATE OUTPUT MODE

OPERATION CODE: 75

MNEMONIC CODE: IOPM

MINOR OPERATION CODE:  $j = 04$

DESCRIPTION: Transfer the contents of  $U$  to the output access-control register and initiate the output mode on the channel specified by the  $a$  designator.

NOTES: The 4-bit contents of the  $a$  designator effectively specify one of sixteen output access-control registers and initiates the output mode on the channel specified by the  $a$  designator.

EXECUTION TIMES:   Alternate Banks 4.0  
                      Same Bank       8.0

## INITIATE MONITORED OUTPUT MODE

OPERATION CODE: 75  
MNEMONIC CODE: IMOM  
MINOR OPERATION CODE:  $j = 05$

DESCRIPTION: Transfer the contents of  $U$  to the output access-control register and initiate the output mode on the corresponding channel. Upon completion of the output transfer, an interrupt will occur.

NOTES: See notes covering *Initiate Output Mode* instruction.

EXECUTION TIMES:   Alternate Banks 4.0  
                      Same Bank       8.0

## OUTPUT MODE JUMP

OPERATION CODE: 75  
MNEMONIC CODE: OMJP  
MINOR OPERATION CODE:  $j = 06$

DESCRIPTION: If the channel specified by the  $a$  designator is in the output mode, jump to  $U$ ; if not, take the next sequential instruction.

NOTES: When  $U$  specifies an address below 200 (octal) and the jump condition is met, the next instruction is taken from the specified address in core memory.

This instruction will only reveal whether the output mode is activated. It does not test the data flow on these lines.

EXECUTION TIMES:   Jump       4.0  
                  No Jump    4.0

#### TERMINATE OUTPUT MODE

OPERATION CODE:       75  
MNEMONIC CODE:        TOPM  
MINOR OPERATION CODE:  *j* = 07

DESCRIPTION: Terminate the output mode on the channel specified by the *a* designator.

NOTES: See notes covering Terminate Input Mode instruction.

EXECUTION TIME:  4.0

#### INITIATE FUNCTION MODE

OPERATION CODE:       75  
MNEMONIC CODE:        IFNM  
MINOR OPERATION CODE:  *j* = 10

DESCRIPTION: Transfer the contents of *U* of the output access-control register and initiate the function mode on the channel specified by the *a* designator.

NOTES: The 4-bit contents of the *a* designator effectively specify one of sixteen output access-control registers, addresses 60 through 77 (octal) in magnetic-film control memory.

In programming input operations, this instruction will be executed after the Initiate Input Mode instruction.

EXECUTION TIMES:  Alternate Banks  4.0  
                  Same Bank        8.0

#### INITIATE MONITORED FUNCTION MODE

OPERATION CODE:       75  
MNEMONIC CODE:        IMFM

MINOR OPERATION CODE:  *j* = 11

DESCRIPTION: Transfer the contents of *U* to the output access-control register and initiate the function mode on the corresponding channel. Upon completion of the function transfer, an interrupt will occur.

NOTES: In programming output operations, this instruction would be executed prior to the *Initiate Output Mode* instruction. After execution, the interrupt caused by the monitor will direct program control to a subroutine. The initiate output mode instruction may be contained within this subroutine, or it may be executed upon completion of this subroutine.

Since function and output modes utilize the same access-control register, the Initiate Output Mode would destroy the function control word in the access-control register before the peripheral unit has received instructions directing it to perform an output operation.

EXECUTION TIMES:  Alternate Bank  4.0  
                  Same Bank        8.0

#### FUNCTION MODE JUMP

OPERATION CODE:       75  
MNEMONIC CODE:        FMJP  
MINOR OPERATION CODE:  *j* = 12

DESCRIPTION: If the channel, specified by the *a* designator, is in the function mode, jump to *U*; if not, take the next sequential instruction.

NOTES: When *U* contains an address below 200 (octal) and the jump condition is met, the next instruction is taken from the specified address in core memory.

This instruction will only reveal whether the function mode has been selected. It will not test the flow of data on the output data lines.

EXECUTION TIMES:  Jump        4.0  
                  No Jump    4.0

#### FORCE EXTERNAL TRANSFER

OPERATION CODE:       75

MNEMONIC CODE: FEXT

MINOR OPERATION CODE:  $j = 13$

DESCRIPTION: Simulate an output request from peripheral equipment associated with the channel specified by the *a* designator.

NOTES: This instruction forces the specified channel into the output mode preparatory to the transmission of function or data words from the computer to the associated peripheral subsystem.

An Output Data Request is simulated. The computer then executes an Initiate Function Mode instruction with the first Function Word being a Terminate operation. In this manner, the current operation of the peripheral subsystem is brought to an orderly halt, without loss of data.

EXECUTION TIME: 4.0

#### ENABLE ALL EXTERNAL INTERRUPTS

OPERATION CODE: 75

MNEMONIC CODE: EAEI

MINOR OPERATION CODE:  $j = 14$

DESCRIPTION: All external interrupts are permitted to occur.

NOTES: The *a* and *u* designators in this instruction are not used.

EXECUTION TIME: 4.0

#### DISABLE ALL EXTERNAL INTERRUPTS

OPERATION CODE: 75

MNEMONIC CODE: DAEI

MINOR OPERATION CODE:  $j = 15$

DESCRIPTION: All external interrupts are prevented from occurring.

EXECUTION TIME: 4.0

#### ENABLE SINGLE EXTERNAL INTERRUPT

OPERATION CODE: 75

MNEMONIC CODE: ESEI

MINOR OPERATION CODE  $j = 16$

DESCRIPTION: Allow an external interrupt to occur on the channel specified by the *a* designator.

EXECUTION TIME: 4.0

#### DISABLE SINGLE EXTERNAL INTERRUPT

OPERATION CODE: 75

MNEMONIC CODE: DSET

MINOR OPERATION CODE:  $j = 17$

DESCRIPTION: Prevent an external interrupt from occurring on the channel specified by the *a* designator.

EXECUTION TIME: 4.0

#### ENABLE ALL INPUT-OUTPUT INTERRUPTS AND JUMP

OPERATION CODE: 74

MNEMONIC CODE: EIJP

MINOR OPERATION CODE:  $j = 07$

DESCRIPTION: Jump to *U* and allow interrupts to occur.

NOTES: The *a* designator in this instruction is not used.

When an interrupt is to be processed, all other interrupts on other channels will be locked out until the current interrupt is processed. Because other internal or external interrupts may be held up, an Enable All Input-Output Interrupts And Jump instruction must be programmed within all input-output interrupt routines, either as the exit back to the main program or before performing any further input-output operations within the interrupt routine.

EXECUTION TIME: 4.0

## WAIT FOR INTERRUPT

OPERATION CODE: 72

MNEMONIC CODE: WAIT

MINOR OPERATION CODE:  $j = 00$

DESCRIPTION: The computer program sequence stops (P is not advanced). This wait condition is removed by the occurrence of an interrupt.

EXECUTION TIME: 4.0

## FUNCTION AND DATA TRANSFERS

Since the information in this chapter is applicable to all input-output operations, the presentation stresses that the execution of an External Function conditions the peripheral subsystem for the desired operation before a data transfer can take place.

### Normal External Function Transfer

Since function transfers are always handled as output data transfers, a normal external function transfer can only take place after the peripheral subsystem has generated the Output Data Request signal. The sequence of operation for a normal external function transfer is as follows:

1. The computer program executes an *Initiate Function Transfer* instruction, either with or without a monitor (operation codes 75  $j=10$  or 75  $j=11$ ).

At this point, the peripheral subsystem generates an Output Data Request signal.

2. The Computer places a function word on the 36 output data lines and generates an External Function signal.
3. The peripheral subsystem senses the signal and gates the information from the output lines to the control section of the subsystem.
4. The peripheral subsystem decodes the function word and prepares for the stipulated operation.

5. The peripheral subsystem generates another Output Data Request signal or an Input Data Request signal, depending upon the type of operation specified in the function word.

### Forced External Function Transfer

The forced external function transfer is used when it is not known whether the Output Data Request signal has been generated by the peripheral subsystem. The sequence of operation is as follows:

1. The computer program executes an Initiate Function Transfer instruction, either with or without a monitor (operation codes 75  $j=10$  or 75  $j=11$ ).
2. To ensure that an Output Data Request signal is generated, the Computer executes a Force External Transfer instruction (operation code 75  $j=13$ ). This instruction causes the signal to be simulated by the Computer's input-output section.
3. The Computer places a Function Word on the 36 output data lines and generates the External Function signal. Normally, the first function will be a Terminate function. This function will bring the subsystem to an orderly halt in the event an operation was being processed at the time the Force External Transfer was executed.

The remaining steps are identical to steps 3, 4, and 5 in the Normal External Function Transfer.

### Normal Input Data Transfer

The sequence of operations for the normal transmission of data from a peripheral subsystem to the Central Computer is described as follows:

1. 75 ( $j=00$  or  $01$  – w/wo monitor). The computer program executes the Initiate Input Transfer instruction which activates the proper input channel.
2. 75 ( $j=10$  or  $11$  – w/wo monitor). Computer program executes an Initiate Function Transfer instruction which activates the proper output channel.
3. Peripheral activates ODR line to notify Computer channel is available.

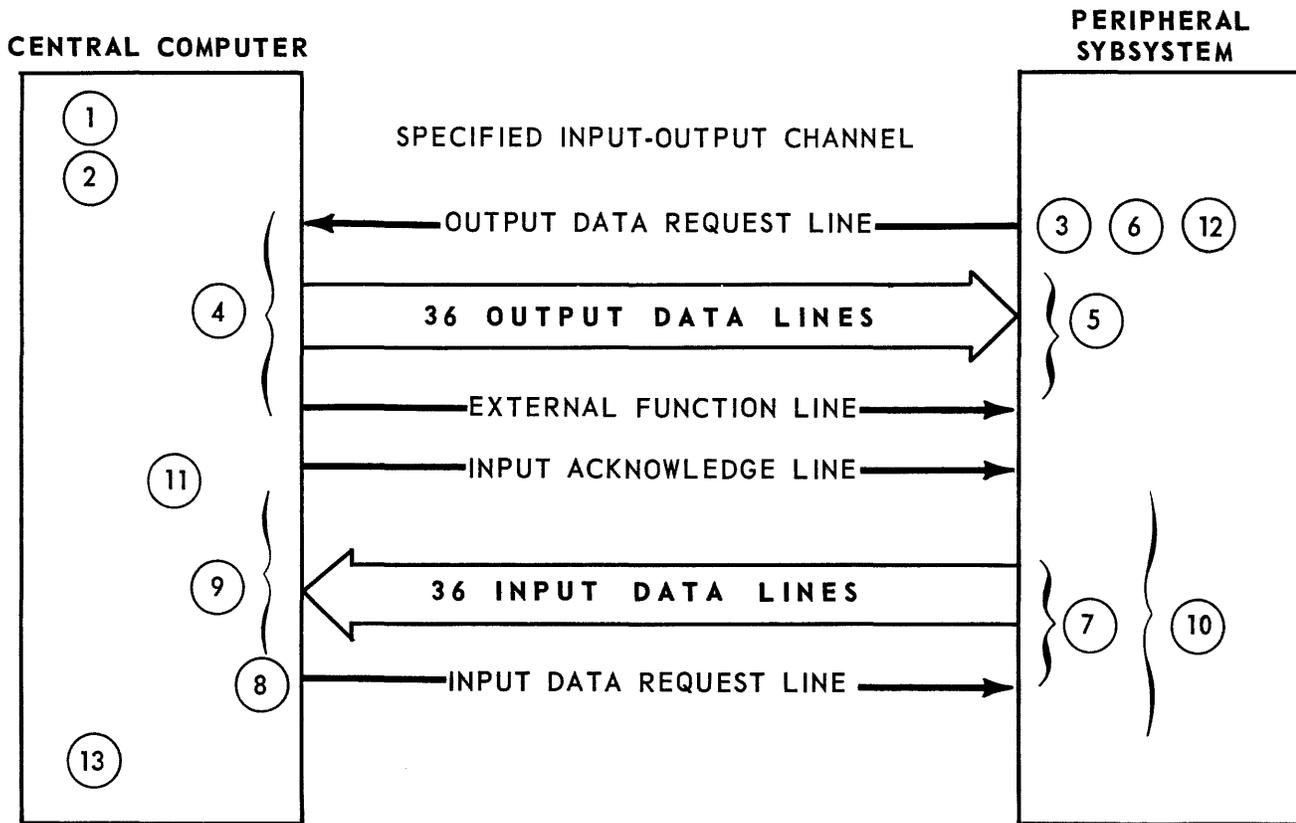


Figure 3-2. Input Data Transfer

4. The Computer puts the first Function Word (36 bits) on the output data lines and sets the EF line signal.
5. The Peripheral Subsystem detects the EF signal, gates the Function Word to its control section, and conditions itself for the designated function.
6. The Peripheral Subsystem reactivates the ODR line. Repeat steps 4 through 6 until the Peripheral Subsystem receives input function.
7. Upon receiving the Input Function, the Peripheral Subsystem places 36 bits of data on data lines and sets the IDR line.
8. The Computer detects the IDR signal.
9. The Computer samples data lines and sets the IA line.
10. The Peripheral Subsystem senses the IA signal and drops the data and the IDR lines.
11. The Computer drops the IA line and repeats steps 7 through 11 until the Peripheral Subsystem senses end-of-data or Computer fails to set IA line.
12. Upon completion of the data transfer, the Peripheral Subsystem energizes the ODR line to signal the Computer the transfer is complete.
13. If the Initiate Input Transfer instruction specified a monitor, internal interrupt is generated upon completion of transfer.

#### Normal Output Data Transfer

The sequence of operations for a normal transfer of data from the Central Computer to a peripheral subsystem is described as follows:

1. 75 (j=10 or 11) the computer program executes Initiate Function Mode instruction which activates the specified output channel.

2. The Peripheral Subsystem activates ODR line to notify the Computer that a channel is available.
3. The Computer places the first Function Word on output data lines and generates an external function signal.
4. The Peripheral Subsystem detects the EF signal, and gates the Function Word to its control section, and conditions itself for function designated.
5. The Peripheral Subsystem re-activates the ODR line. *Repeat steps 4 through 5 until the Peripheral Subsystem accepts the last Function Word.*
6. 75 (j=04 or 06) The Computer initiates the Initiate Output Transfer mode instruction giving the program selected channel access to memory.
7. The Computer detects the ODR signal from the Peripheral Subsystem and may, at this point, execute another Forced Transfer.
8. The Computer places the data word on the output data lines and generates an OA signal.
9. The Peripheral Subsystem senses the OA signal, drops the ODR signal, and accepts the data word.
10. The Computer drops the OA signal and the data lines.
11. The Peripheral Subsystem generates another ODR signal. *Steps 7 through 11 are repeated for each word in data block. If Initiate Output Mode Instruction was with monitor, an internal interrupt will occur upon completion of transfer.*

### CHANNEL CONDITIONS

Two conditions can occur on a given channel: normal and abnormal. In the normal condition, the channel will be in a cleared state with an Output Data Request up. This means that data words or Function Words are not being transmitted.

A channel is in the abnormal condition: during input and output transfers (upon termination, the channel will return to the normal condition); after internal termination of a continuous drum operation; or while holding an external interrupt for processing. A channel may be forced into the normal condition by executing the *Force External Function Transfer* sequence.

These two conditions, normal and abnormal, should not be confused with the three types of communication modes; input, output, and function. The modes signify the type of operation the channel is prepared to handle, while the conditions reveal the status of the peripheral subsystem.

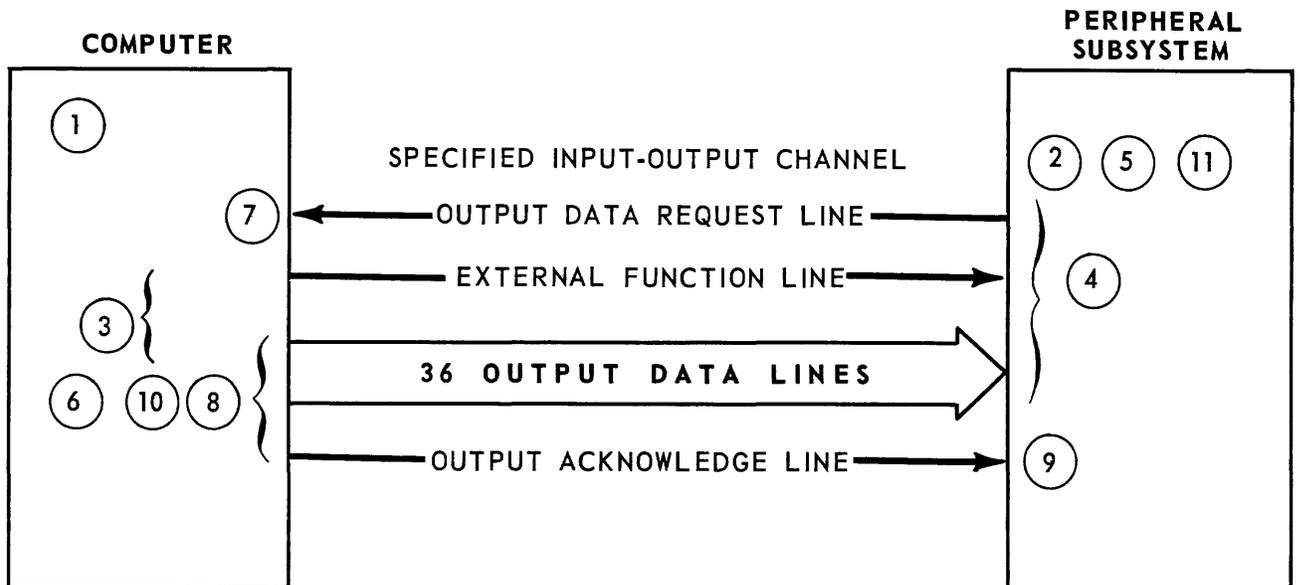


Figure 3-3. Output Data Transfer

## 4. STANDARD PERIPHERAL SUBSYSTEMS

The standard peripheral subsystems are:

- *Magnetic Drum*
- *Magnetic Tape*
- *Paper Tape*
- *High-Speed Printer*
- *Punched Card*

As previously mentioned, each subsystem consists of one or more units of the same type, a Control Unit, and a Channel Synchronizer.

### MAGNETIC DRUM SUBSYSTEM

A Magnetic Drum FH-880 Subsystem consists of from one to eight FH-880 Magnetic Drum Units (Figure 4-1), an FH-880 Magnetic Drum Control Unit, and a Channel Synchronizer. Since each drum can store 786,432 thirty six-bit words, the total capacity of a full eight drum subsystem is 6,291,456 words.

Programmed instructions initiate the transfer of any number of words up to full capacity of the drums connected to the channel. Transfers can begin at any location and continue sequentially through the last storage address. The starting address can be on drum #0 and the final address on drum #7. The word transfer rate to the Computer can be varied by interlacing the data words. Transfers between drums and core memory begin at the time the angular position of the drum coincides with the specified starting address.

The FH-880 Magnetic Drum Control Unit controls the flow of information between the drum units and the Channel Synchronizer. It will accept 6-bit output data characters from the synchronizer and distribute them to the drum units as specified by the program. The Control Unit also transmits 6-bit input data characters to the Channel Synchronizer.

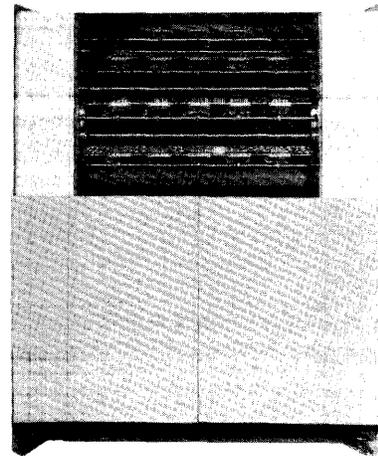


Figure 4-1. FH-880 Magnetic Drum Unit

Several errors are detected by the Magnetic Drum Subsystem:

*Parity Error.* Each data word is recorded with odd parity. If even parity is detected during a read operation, a parity error interrupt occurs.

*Character Count.* Whenever fewer than six characters per word are transferred to or from the drum, a character count error interrupt takes place.

*Illegal Function.* Each operation requested of the drum subsystem is checked for validity. An operation code (bits 35 through 30 of the Function Word) which is not included in the repertoire causes an illegal function interrupt to occur. (Function codes for the Magnetic Drum Subsystem are presented in Appendix A.)

*Invalid Address.* Any address beyond the capacity of the drum subsystem results in an invalid address interrupt.

To initiate any operation, the Computer sends a Function Word which defines the operation to be performed and specifies the storage address where the operation is to begin. The operation to be performed, or function, is contained in bit positions 35 through 30 of the Function Word.

In respect to the FH-880 Magnetic Drum Subsystem, the operations included in the function repertoire are as follows:

FUNCTION	CODE (OCTAL)
Continuous Write	02
Continuous Read	42
Block Read	52
Search	45
Block Search	55
Search Read	46
Block Search Read	56
Terminate	23
Bootstrap (Initial Load)	40

In the execution of a Continuous Write, a write operation begins at the address specified in the Function Word and continues through successive addresses until terminated by the terminate instruction, the last storage address, a character count error, or a parity error. The Continuous Read is performed in a similar manner with data being transferred from the drum to the Computer.

The Block Read starts a read operation at the address specified in the Function Word and continues through successive addresses until terminated by the terminate instruction, the last storage address, a character count error, a parity error, or an end-of-block word (a word consisting of all binary ones).

The Search cannot proceed until an identifier word is transferred to the drum subsystem. The identifier word may be any full length computer word and is compared bit-by-bit with data read from the drum. The search begins at the address specified in the Function Word and continues through successive addresses until terminated by a *find*, the terminate instruction, the last storage address, a character count error, or a parity error.

The Block Search is the same as the Search except that after an end-of-block word is detected, one more word is transferred to the Computer. This word can be an overflow address indicating the next link in a chain of information.

The Search Read operation begins at the address specified in the Function Word. The contents of each address are compared bit-by-bit with the identifier word. When a *find* is made, the continuous read operation begins. The continuous read will utilize successive addresses until terminated by the terminate instruction, the last storage address, a character count error, or a parity error.

A Block Search Read is the same as the Search Read except that after an end-of-block word is detected, one more word is sent to the Computer. This word can be an overflow address indicating the next link in a chain of information.

The Terminate signifies the end of the current operation. In a write operation, all transfers stop as soon as the current data word is transferred to the drum surface. The transfer stops immediately if the data word is being transferred from the drum.

The Bootstrap is a combination instruction. The drum subsystem terminates the current operation and starts a Continuous Read from address zero.

## MAGNETIC TAPE SUBSYSTEM

The Magnetic Tape Subsystem consists of from two to twelve UNISERVO\* II A Magnetic Tape Units (see Figure 4-2), a Magnetic Tape Control Unit, and a Channel Synchronizer.

The UNISERVO unit utilizes one-half inch plastic or metallic tape in UNIVAC Computer standard format. This subsystem provides for read or write operations on any of the twelve tape units. However, concurrent read and write operations are not provided.

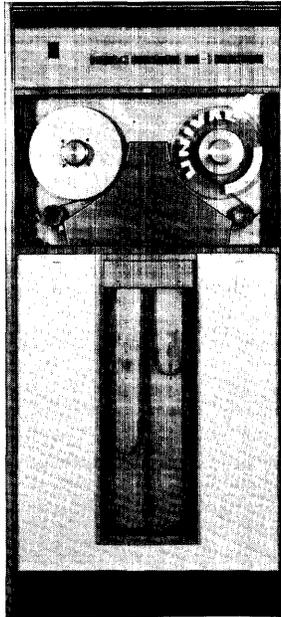


Figure 4-2. UNISERVO IIA Magnetic Tape Unit

Several types of checking are provided by the Magnetic Tape Subsystem:

*Bad Spot Detection.* Photocell circuits in the UNISERVO Unit constantly monitor the tape for bad spot indications during both read and write operations. When a bad spot occurs, the detection circuits interrupt the read or write operation for the duration of the bad spot. Tape movement, however, continues throughout the bad spot area. A bad spot detected during a write operation will cause three characters of a word to be written before the bad spot and three characters to be written after the bad spot.

*Parity Error.* Each character of data is recorded with odd parity. Whenever even parity is detected, a parity error interrupt occurs.

*Character Count.* Whenever all six characters in a word are not transferred to or from the tape, a character count error interrupt occurs.

*Illegal Function.* Each operation requested of the tape subsystem is checked for validity. A function code (bit positions 35 - 30 of the partial word) which is not included in the tape repertoire causes an illegal function interrupt to occur (see Appendix A for invalid magnetic tape function codes).

*Attempted Operation on an Interlocked Unit.* If the power or door interlocks on a tape unit are activated, the unit will not respond and an interlock interrupt takes place.

*Attempted Write on Master Tape Reel.* An attempted write operation on a unit containing a master tape reel will not be performed. An interlock interrupt will occur.

To initiate a tape operation, the Computer sends a Function Word. This word defines the operation to be performed and the address of the tape unit involved. The operation to be performed is contained in bit positions 35 through 30 of the Function Word. Bit positions 11 through 0 define the selected UNISERVO Unit. Whenever a Search Read operation is specified, an identifier word must immediately follow the Search Read Function Word.

The function repertoire for the Magnetic Tape Subsystem is as follows:

FUNCTION	CODE (OCTAL)
Write one block (RRU format) 12.5 kc	01
Write one block (RRU format) 25 kc	02
Write one block (RRU format) with interrupt 12.5 kc	11
Write one block (RRU format) with interrupt 25 kc	12
Rewind tape	20
Rewind tape with interrupt	30
Rewind tape and interlock	21
Rewind tape and interlock with interrupt	31
Bootstrap (initial load)	40
Bootstrap (initial load) with interrupt	50
Read forward one block, low gain	41
Read forward one block, low gain with interrupt	51
Read forward one block, normal gain	42
Read forward one block, normal gain with interrupt	52
Read forward one block, high gain	43
Read forward one block, high gain with interrupt	53
Search read, low gain	45
Search read, low gain with interrupt	55
Search read, normal gain	46
Search read, normal gain with interrupt	56
Search read, high gain	47
Search read, high gain with interrupt	57
Read tape backward one block, low gain	61
Read tape backward one block, low gain with interrupt	71
Read tape backward one block, normal gain	62
Read tape backward one block, normal gain with interrupt	72
Read tape backward one block, high gain	63
Read tape backward one block, high gain with interrupt	73
Search read backward, low gain	65
Search read backward, low gain with interrupt	75
Search read backward, normal gain	66
Search read backward, normal gain with interrupt	76
Search read backward, high gain	67
Search read backward, high gain with interrupt	77

The Write instructions cause the writing of one data block at 250 bits per inch. Writing is terminated when the end-of-block is detected. (End-of-block is defined as the absence of tape data for two character times, i.e., 160  $\mu$ s at a density of 12.5 kc and 80  $\mu$ s at a density of 25 kc.)

The Rewind instruction requests the tape to be rewound to the first data block. After the tape has been rewound, a Rewind Interrupt, if requested, will occur. The rewind with interlock instruction prevents subsequent operations from unwinding the rewound tape.

The Bootstrap instruction performs a dual function. The tape is rewound to the first data block, after which the first data block is read.

The Read instruction causes one block of data to be read. Three variations in gain are provided: low, normal, and high. Upon terminating the read operation, a read-terminate interrupt, if programmed, will occur.

The Search Read instruction compares an identifier word character-by-character with the first word in each block read. Upon a *find* the block is read. Three gain variations are available as well as a read-termination interrupt.

Both read and search read operations may be performed with the tape moving in a backward direction. The backward Read and Search Read commands are the same as their counterparts except that they cause the last word of a block to be read first.

## PAPER TAPE SUBSYSTEM

The Paper Tape Subsystem consists of a modified Teletype BRPE-11 Paper Tape Punch and a Digitronics Model B 3500 Paper Tape Reader a Paper Tape Control Unit, and a Channel Synchronizer.

The Paper Tape Subsystem provides for 11/16, 7/8, and 1-inch tape widths. All punched data is verified by a magnetic post-sensing station. The Paper Tape Subsystem is capable of reading 350 frames per second and punching 110 frames per second. Concurrent reading and punching is not provided.

The Paper Tape Subsystem provides for several types of checking:

*Parity Error.* When reading, each frame of data can be checked for odd or even parity. If parity does not check, a parity error interrupt occurs. In punching operation, each bit is verified.

*Character Count Error.* Whenever all six characters in a word are not transferred to or from the reader or punch, a character-count-error interrupt occurs.

*Illegal Function.* Each operation requested of the Paper Tape Subsystem is checked for validity. A function code (bit positions 35 – 30 of the Function Word), which is not included in the paper tape repertoire causes an illegal function interrupt (Appendix A).

To initiate any paper tape operation, the Computer sends a Function Word. This word defines the operation to be performed, the format to be used, and the unit involved. The operation to be performed is contained in bit positions 35 through 30 of the Function Word. The format of the transfer is defined by bit position 18. The contents of the four low-order bit positions 1 and 0 stipulate which of the four units is involved in the operation.

Following is a list of the functions included in the paper tape repertoire:

FUNCTION	CODE (OCTAL)
Punch with parity	02
Punch, no parity	01
Read with parity	42
Read, no parity	41
Terminate	23
Terminate with interrupt	33

The Punch with parity instruction has two variations; a six-bit format or an eight-bit format. When the six-bit format is selected, the 36-bit computer word is recorded on the paper tape in six frames. Each frame consists of six data bits plus a parity bit. The parity bit is generated by the Paper Tape Control Unit, while odd or even parity is determined by a switch on this unit. This format may be used with either 7/8 or 1-inch tape.

When the eight-bit format is used, the computer word is recorded on paper tape in three frames. Each frame consists of seven data bits plus a parity bit. This format is used with 1-inch tape only. Punched data is verified, bit-by-bit, by comparing the original data with parity to the data read by the post sense station.

The Punch with no parity instruction also has two options: a 6-bit format and an 8-bit format. When the 6-bit format is used, the computer word is recorded on paper tape in six frames. Each frame consists of up to six data bits for the 7/8 and 1-inch tapes and up to five data bits for the 11/16-inch tape.

When the 8-bit format is used, the computer word is recorded on paper tape in three frames. Each frame, in this case, consists of up to eight data bits for the 1-inch tape. The other two tape widths are not available with this option.

The Read with parity instruction may be executed with one of two options: a 6-bit format or an 8-bit format. When the six-bit format is employed, six frames from the tape are assembled into one computer word. The parity of each frame is checked as defined by the parity selection switch on the paper tape control unit. This format may be used with 7/8 or 1-inch paper tapes. When the 8-bit format is used, three frames from the tape are assembled into one computer word. Both the 7/8 and the 1-inch tapes may be used with this option.

The Read with no parity instruction may employ either a 6-bit format or an 8-bit format. When the 6-bit format is used, six tape frames are assembled into one computer word. No verification is provided. This format may be used with 11/16, 7/8, or 1-inch tapes. When the 8-bit format is used, three tape frames are assembled into one computer word. This format can be used with either 7/8 or 1-inch tapes.

The Terminate instruction ends the operation in progress. During output operations, all transfers stop after the current data word has been transmitted to the tape. Transfers stop immediately if data is being read from tape.

### HIGH-SPEED PRINTER SUBSYSTEM

The High-Speed Printer Subsystem is composed of one (or two) Model 46 High-Speed Printer (Figure

4-3), a High-Speed Printer Control Unit, and a Channel Synchronizer. The Model 46 High-Speed Printer is an electromechanical unit which performs the actual printing of a line under the control of the High-Speed Printer Control Unit.

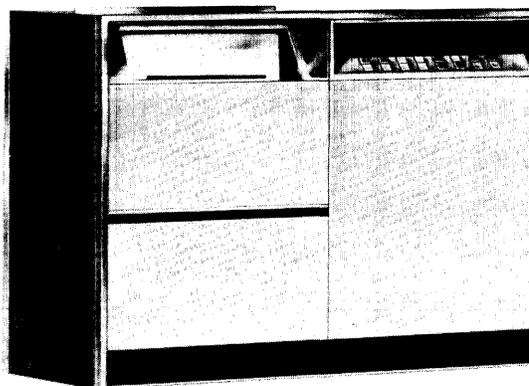


Figure 4-3. High-Speed Printer

Two types of checking are provided by the High-Speed Printer Subsystem:

*Character Count Error.* Whenever all six characters in a word are not transferred to the printer, a character-count error interrupt occurs.

*Illegal Function.* Each operation requested by the High-Speed Printer Subsystem is checked for validity. Any operation which is not included in the function repertoire causes an illegal function interrupt (Appendix A).

The Print Function Word determines which operation the Printer will perform. The desired operation is contained in bit positions 35 through 30 of the Function Word. Bit positions 23 through 18 determine the spacing (0 to 63) while bit positions 5 through 0 actually select the printer.

The function repertoire of the High-Speed Printer includes the following operations:

FUNCTION	CODE (OCTAL)
Output function, type 2	02
Output function, type 2 with external interrupt	12
Output function, type 3	03
Output function, type 3 with external interrupt	13

Type 2 output functions cause the High-Speed Printer to operate at a spacing rate of six lines to the inch. Type 3 output functions (only applicable to

the Model 151 High-Speed Printer which will be available in the future) specify line spacing of eight lines to the inch.

### PUNCHED-CARD SUBSYSTEM

The Punched-Card Subsystem consists of a Modified Model 45 Card Reader and a Model 67 Card Punch Unit (Figure 4-4), a Card Control Unit, and a Channel Synchronizer.

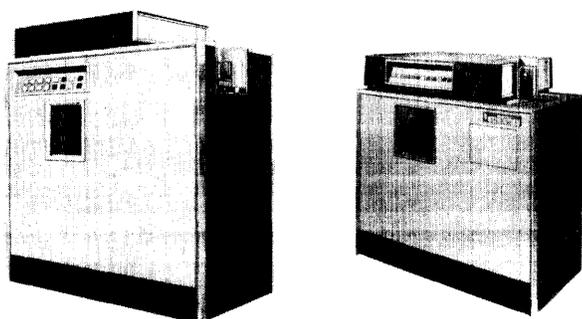


Figure 4-4. Card Reader and Card Punch

The subsystem can sense and check 80-column cards at the continuous rate of 600 cards per minute. The subsystem can punch and sense 80-column cards at the rate of 150 cards per minute. Concurrent sensing and punching can be accomplished at the continuous combined rate of 750 cards per minute. The punch unit is capable of sensing data that has already been punched into the cards. Besides availability of a 90-column card system, provision is made for read-punch operations utilizing a single unit.

Provision has been made in the Punched-Card Subsystem for the following types of checks:

*Illegal Function.* Each operation requested of the card subsystem is checked for validity. Any operation which is not included in the punched-card function repertoire causes an illegal function interrupt.

*Punch Error.* A hole count is performed as the card is punched and this count is compared to the hole count at the post sense station. If an error occurs, a punch-error interrupt is indicated to the Computer.

*Read Error.* A bit-by-bit comparison of the data read from the card at each of two sensing stations is compared. A discrepancy will cause a read-error interrupt.

To initiate an operation in the Punched-Card Subsystem, the Computer sends a Function Word to the subsystem. The desired operation is contained in bit positions 35 through 30 of this word.

Included in the repertoire of the Punched-Card Subsystem, are the following operations:

FUNCTION	CODE (OCTAL)
Punch one card	02
Punch one card and select stacker	03
Translate from machine to card code	04
Receive output card image by column	05
Receive output card image by row	06
Punch one card, and interrupt	12
Punch one card, select stacker, and interrupt	13
Translate output from machine to card code and interrupt	14
Receive output image by column and interrupt	15
Receive output card image by row and interrupt	16
Clear Local*	22
Terminate present operation	23
Request availability*	24
Clear remote*	26
Clear Local type 2*	32
Terminate and interrupt	33
Request availability with interrupt*	34
Clear remote with interrupt*	36
Read one card but do not feed cards	41
Read one card and feed cards	42
Feed one card but do not read	43
Translate next input data from card to machine code	44
Read next card image by column	45
Read next card image by row	46
Read one card, no feed, and interrupt	51
Read one card, feed cards, and interrupt	52
Feed one card, no read, (type 2)	53
Read next card image by column and interrupt	55
Translate next input image from card to machine code and interrupt	54
Read next card image by row and interrupt	56
Select stacker 1	61
Select stacker 2	63
Select stacker 1 and interrupt	71
Select stacker 2 and interrupt	72

\* Applies to a two-computer installation

The preceding function codes, along with those pertaining to the other standard peripheral subsystems, will be explained in detail in subsequent publications.

## 5. SYSTEM CONFIGURATIONS

In general terms, the UNIVAC 1107 Thin-Film Memory Computer System consists of a UNIVAC 1107 Central Computer and a number of versatile peripheral subsystems. The exact configuration of a given system is contingent upon the customer's data-processing requirements.

### TYPICAL 1107 COMPUTER SYSTEM

In a typical installation, the UNIVAC 1107 Thin-Film Memory Computer System, with recourse to an Executive Routine, might consist of the following:

- An 1107 Central Computer with a 65,536-word core memory. (The Central Computer includes the Control Console.)
- One FH-880 Magnetic Drum Subsystem containing two FH-880 Magnetic Drums.
- One FH-880 Magnetic Drum Subsystem containing four FH-880 Magnetic Drums.
- One Magnetic Tape Subsystem containing four UNISERVO IIA Magnetic Tape Units.
- One High-Speed Printer Subsystem containing one High-Speed Printer.

- One 80-column Punched-Card Subsystem containing one 80-column Card Punch Unit and one 80-column Card Reader.
- One Paper Tape Subsystem containing one Paper Tape Reader and one Paper Tape Punch.

In the example, the UNIVAC 1107 Computer System utilizes only seven of the sixteen input-output channels. Up to nine additional subsystems can be incorporated into the basic system to meet increased processing requirements. Additional units within some subsystems can be added when necessary. For example, eight more Magnetic Tape Units.

### UTILIZATION OF PERIPHERAL EQUIPMENT

As shown in Figure 5-1, the UNIVAC 1107 Computer System described above employs one FH-880 Magnetic Drum Subsystem (two units) for storage of the UNIVAC 1107 System's programs. The second Magnetic Drum Subsystem (four units) provides storage for output data.

The Magnetic Tape Subsystem is used to provide storage for product programs and output data.

The High-Speed Printer Subsystem provides printed output data as well as graphic illustrations.

The 80-column Punched-Card Subsystem performs the permanent recording of output data. It also furnishes the Central Computer with pre-recorded input data. In addition, the Card Reader can accept pre-recorded cards from other computer systems.

The Paper Tape Subsystem is used for transferring small computer programs as well as program parameters to the Central Computer.

Monitoring of a running program is made via the Control Console which includes both a keyboard and type printer.

## COMMUNICATIONS

The maximum input-output transfer rate is directly dependent upon the cycle time of core memory. With a basic cycle time of 4.0 microseconds, the transfer rate of a UNIVAC 1107 memory bank is 250,000 words per second. However, because cycle time is required for purposes other than input and output (for example, accessing constants and instructions), this transfer rate cannot be fully maintained. In writing a specific program, the maximum concurrent input-output transfer rate will reflect the application's internal data-processing requirements. As a general rule, the maximum input-output transfer rate will not exceed 125,000 words per second.

The UNIVAC 1107 System previously described has the following input-output transfer rates:

ONE CHANNEL	WORDS PER SECOND
Magnetic Drum (two units)	60,000
Magnetic Drum (four units)	60,000
High-Speed Printer (one unit)	4,166
Magnetic Tape (four units)	4,166
Card (one reader, one punch)	1,400
Paper Tape (one reader, one punch)	67

Because External Functions must be initiated after each input-output sequence operation, the actual transfer rates for each channel are less than the stated figures. Accordingly, the total transfer rate will be considerably below 125,000 words per second.

## APPLICATIONS

The UNIVAC 1107 Thin-Film Memory Computer System is readily adaptable to many specialized applications. Configurations for three of these applications are presented in the following paragraphs. The additional units are described in the beginning of this chapter.

## INVENTORY AND PROCESS CONTROL SYSTEMS

In an inventory and process control system, the primary input-output media are cards and printed information. Conceivably, this system could be required to process 1,500 to 2,000 cards per minute and to produce file printouts and graphical representations in the same period. To meet these requirements, two 80-column Punched-Card Subsystems and one High-Speed Printer Subsystem are added to the system.

## TRAFFIC CONTROL SYSTEMS

A traffic control system requires high-speed mass storage of data and the addition of specialized peripheral equipment. To provide storage for ten-million words, two Magnetic Drum Subsystems (eight drums per subsystem) are added. The specialized peripheral subsystems can be connected to the remaining input-output channels.

## TACTICAL DATA AND SURVEILLANCE SYSTEMS

This type of application requires five to ten-million words of high-speed storage, ten to twenty-million words of temporary storage, a facility for simultaneous listing of files, and input-output channels for special peripheral subsystems. To meet these requirements the typical system is expanded to two Magnetic Drum Subsystems (eight drums per subsystem), a full-scale Magnetic Tape Subsystem (twelve UNISERVO Units), and two High-Speed Printer Subsystems (one printer per subsystem). The remaining input-output channels can accommodate eight special peripheral subsystems.

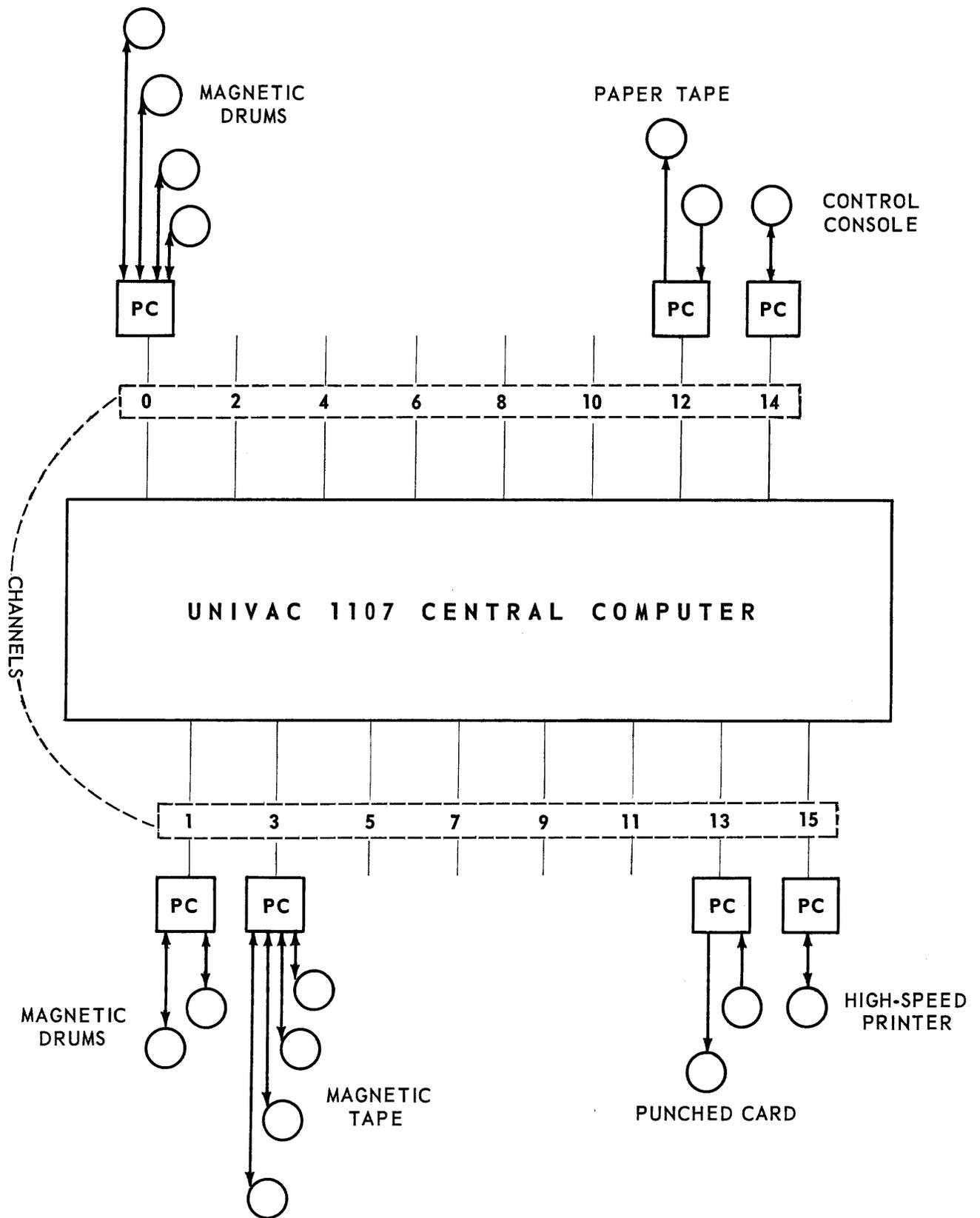


Figure 5-1. Typical UNIVAC 1107 Thin-Film Memory Computer System

# APPENDIX A. FUNCTION CODES

MODE	FUNCTION CODE (OCTAL)	MAGNETIC TAPE	MAGNETIC DRUM	PAPER TAPE	PUNCHED CARD	HIGH-SPEED PRINTER
OUT	01	X		X		
"	02	X	X	X	X	X
"	03				X	X
"	04				X	
"	05				X	
"	06				X	
	07					
	10					
OUT	11	X				
"	12	X			X	X
"	13				X	X
"	14				X	
"	15				X	
"	16				X	
	17					
FUNCT.	20	X				
"	21	X				
"	22				X	
"	23		X	X	X	
"	24				X	
	25					
FUNCT.	26				X	
	27					
FUNCT.	30	X				
"	31	X				
"	32				X	
"	33			X	X	
"	34				X	
	35					
FUNCT.	36				X	
	37					
IN	40	X	X			
"	41	X		X	X	
"	42	X	X	X	X	
"	43	X			X <sup>1</sup>	
"	44				X	
"	45	X	X <sup>1</sup>		X	
"	46	X	X		X	
"	47	X				
FUNCT.	50	X				
IN	51	X			X	
"	52	X	X		X	
"	53	X			X <sup>1</sup>	
"	54				X	
"	55	X	X <sup>1</sup>		X	
"	56	X	X		X	
"	57	X				
	60					
IN	61	X			X <sup>1</sup>	
"	62	X				
"	63	X			X <sup>1</sup>	
	64					
IN	65	X				
"	66	X				
	67	X				
	70					
IN	71	X			X <sup>1</sup>	
"	72	X			X <sup>1</sup>	
"	73	X				
	74					
IN	75	X				
"	76	X				
"	77	X				

<sup>1</sup> A function, rather than an input or output, operation is performed

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