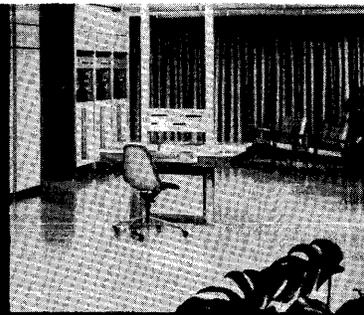


**UNIVAC<sup>®</sup>  
490**



**REAL-TIME SYSTEM**

**TECHNICAL BULLETIN**

***UNIVAC 490***

***UNISERVO Subsystem***

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# 1. Introduction

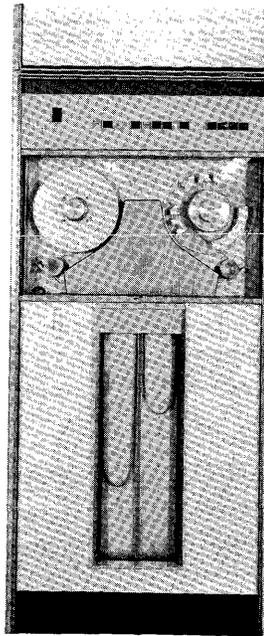


Figure 1-1. UNISERVO IIA Magnetic Tape Unit

The Magnetic Tape Subsystem is an integral part of the UNIVAC® 490 Real-Time System. As many as twelve UNISERVO\* IIA Magnetic Tape Units may be connected to the UNIVAC 490 Computer on each of the available input-output channels. A Channel Synchronizer-Control Unit is utilized on each input-output channel to control the tape units on that channel.

Operating as an input-output unit, a Magnetic Tape Subsystem on one input-output channel is capable of reading or writing on any one of a maximum of twelve UNISERVO Units at any one time. If operation requires simultaneous read and write operations, two input-output channels must be employed. This means that a tape may be read, up-

dated, and rewritten on an output tape in the time required for the original reading.

A number of checks is incorporated into the unit to provide and maintain accuracy of information as it is read and recorded. Operator's control panels advise the operator of conditions existing within a subsystem at any given moment. A switch on the front panel of each UNISERVO Unit permits interchanging of metallic or MYLAR\* tape.

The accuracy, ease of operation and extensive storage facilities provided by the Magnetic Tape Subsystem are significant features of the UNIVAC 490 Real-Time System.

\* Trademark of the Sperry Rand Corporation.

\* MYLAR is a registered trademark of the E. I. du Pont de Nemours & Co., Inc.

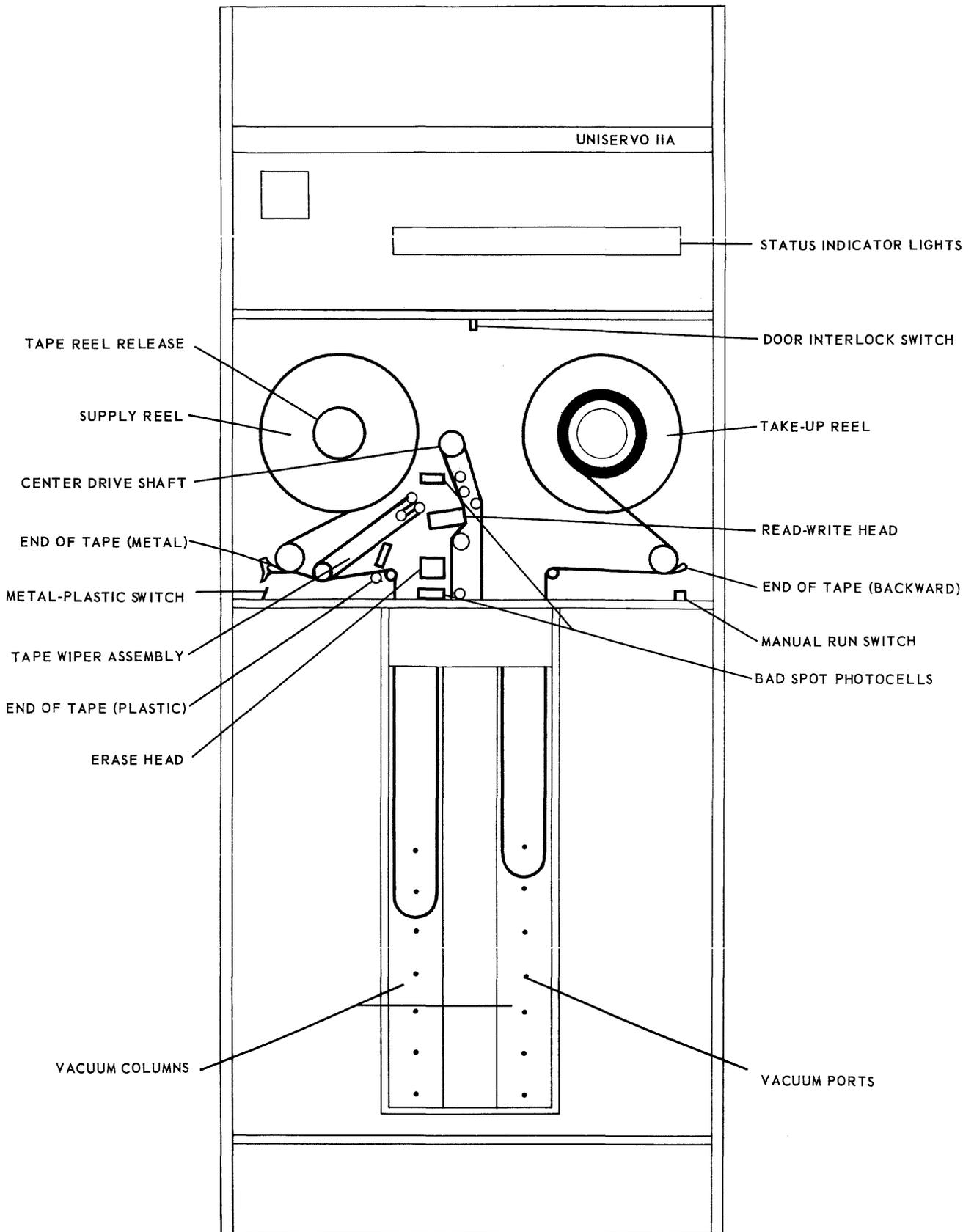


Figure 2-1. Schematic of UNISERVO IIA Magnetic Tape Handling Unit.

## 2. UNISERVO IIA Unit Functional Description

The UNISERVO IIA Unit is used to record on magnetic tape or to read data previously recorded on magnetic tape. A Channel Synchronizer-Control Unit is required to control up to twelve tape units on each tape input-output channel.

### OPERATING FEATURES

Figure 2-1 is a basic diagram of a UNISERVO Unit. The reel of tape containing the data to be processed, or the blank tape on which information is to be recorded, is mounted on the left. The right-hand reel is used to take-up the slack in the tape as it is read or written upon. The take-up reel is affixed to the UNISERVO Unit.

As shown in the diagram, the tape is threaded around and through guide rollers which control the path of the tape between the supply and the take-up reels. A pre-threaded leader is permanently affixed to the take-up reel. When it becomes necessary to mount a new supply reel, the end of the tape on the supply reel is attached to the leader, eliminating the need for threading. Supply reels may easily be changed in about thirty seconds.

The read-write head performs the actual reading or writing of information on the tape. The erase head is used only during a write operation. It erases information on the tape before new information is written.

The vacuum columns, located below the tape reels, are used as temporary storage areas for the tape before it passes beneath the read-write head or before it is wound on the take-up reel. The tape slack is necessary to permit the rapid acceleration, by the center drive shaft, of a short section of tape, allowing time for the reels to be activated or halted. When the tape loop in the left-hand column is shortened, more tape is fed from the supply reel. Similarly, when the tape loop in the right-hand column is lengthened the take-up reel takes up the slack. The tape loops in both columns remain at a nearly constant length.

In order to remove a tape which has been read or written on, the tape must first be rewound to the supply reel. To rewind a 1,500-foot reel of tape requires approximately three minutes; a 2,400-foot reel, approximately five minutes.

### TAPE FORMAT

Characters are recorded on magnetic tape as unique combinations of magnetic spots. Each character is composed of six data bits, to which are added one parity bit and one sprocket bit. The sprocket bit is used as a timing device in the reading of data from the tape. The arrangement of UNIVAC Code data characters on the tape is shown in Figure 2-2. Any character code may be used. The sprocket channel has been omitted because it is not pertinent to the discussion.

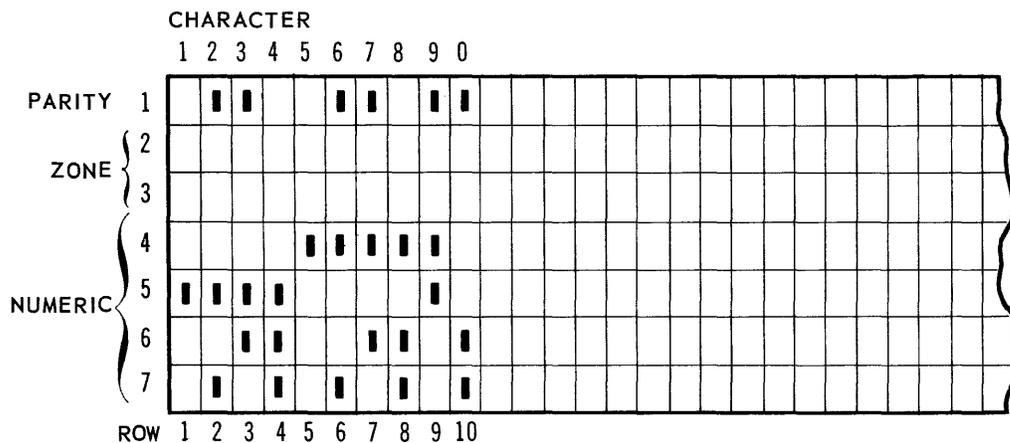
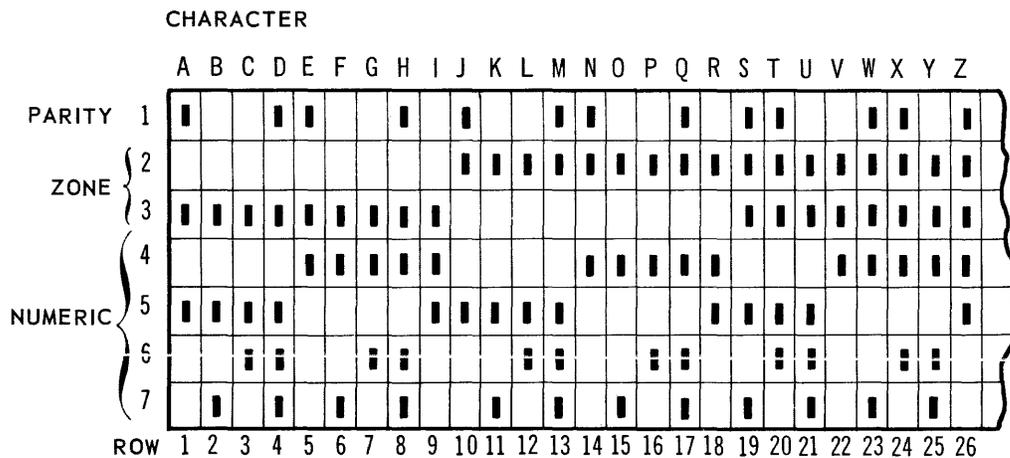


Figure 2-2. UNIVAC XS-3 Coded Data on Tape

The smallest division of data written on the tape is a UNIVAC 490 30-bit word. UNIVAC 490 Data Words are written on the tape in groups of five 6-bit characters (8-bit frames) per word. Words are written on the tape in blocks. Because variable block length format is used, a block may contain any number of words.

Characters may be recorded at a density of either 125 or 250 characters per inch. The space between the blocks written on the tape is 1.2 inches which constitutes an interblock time of 12 milliseconds. The leader delay is 20 feet 10 inches or approximately 2,500 milliseconds. The end of file is detected by the absence of data for 3.5 inches, or 35 milliseconds. Start and stop time are 5 milliseconds, plus 7 milliseconds handling time.

As an additional feature, tapes pre-recorded at 50 (UNITYPER\*), 125 and 250 characters per inch may be read by the UNISERVO Unit.

\* Trademark of the Sperry Rand Corporation.

### BAD SPOT DETECTION

Photocell circuits in the UNISERVO Unit constantly monitor the tape for bad spot indications. When the bad spot occurs, the detection circuits cause the write or read function to be interrupted for the duration of the spot. The tape movement continues throughout the bad spot area.

If a bad spot is detected during a write function, part of the Data Word is written before the bad spot area and the other part is written after it. The Magnetic Tape Subsystem used with the 490 Computer writes three data characters before the bad spot area and two after it.

Bad spot areas on tape are indicated by marking the tape. Bad spots on metal tape are marked by punching holes at specified intervals in the tape throughout the bad spot area. Bad spots on plastic tape are marked by scraping the tape (removing some oxide coating) at specified intervals throughout the bad spot area.

## **CHECKING**

Magnetic tapes are checked for accuracy by making use of a parity bit as well as by counting the number of characters written or read.

### **Parity Checking**

Parity errors occur only during read or search-read operations, not during a write operation. Although parity is checked on the reading of each character, an entire block is read whether or not a parity error has been detected. Parity error indication is given at the end of the block.

### **Character-Count Error**

The character-count error occurs when a multiple of five characters is not available to read or write. On a read or search-read operation, the character-count error will occur as the last word of a block.

### **INHIBIT WRITE RING**

A metal ring may be inserted on the inside diameter of the input data reel. When this reel is in place it will prevent the UNISERVO Unit on which it is mounted from executing a write instruction; however, it will not affect a read instruction or a rewind instruction. The possibility of inadvertently writing on a master data tape is thereby eliminated.

### 3. Channel Synchronizer-Control Unit

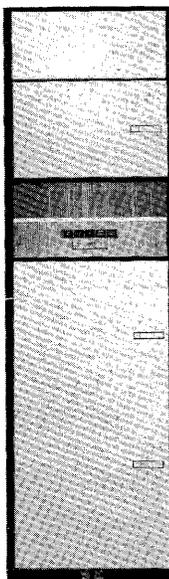


Figure 3-1. Channel Synchronizer - Control Unit

The Channel Synchronizer-Control Unit controls the operation of the UNISERVO Units during their write and read functions, transfers the data to be written from the Computer to the UNISERVO Units, and transfers the data which has been read from the UNISERVO Units to the Computer.

#### WRITE FUNCTION

During the write function, the unit receives Function Words from the 490 Computer, and translates these Function Words into write-control commands to the UNISERVO Units. Then it receives Data Words from the Computer, and transfers these Data Words to the UNISERVO Units for writing on tape.

#### READ FUNCTION

During the read function, the Channel Synchronizer-Control Unit receives Function Words from the 490 Computer, and translates these functions into read-control commands for the UNISERVO

Units. Then it receives data from the UNISERVO Units and transfers this data to the Computer.

#### UNISERVO Selection

The Channel Synchronizer-Control Unit selects the UNISERVO Units specified in the Function Word.

#### Error Detection

Detection circuits in the Channel Synchronizer-Control Unit check the data characters received from the UNISERVO Units for proper parity. They also check the Data Words for the proper number of characters in a word.

#### Format Control

Format control circuits control the recording density, either 125 or 250 characters per inch, during the write function.

## 4. Programming Features

Any part of the Computer's internal core storage can be used as an input-output data buffer storage area, with the exception of the few special core storage locations that are reserved for the Incremental Clock and the Interrupt Words. Information is transferred between the Computer and the UNISERVO Unit in *blocks* of data. A block may contain any number of words; however, each word transferred must be complete (all 30-bits must be transferred). Words in a block must occupy consecutive core memory addresses, starting with a program determined first word address and ending with a program determined last word address. The internally specified index mode will always be used.

### BUFFER MODE

A buffer mode transfer, which occurs independently of main program control, is used to transfer data between core storage and the UNISERVO Units. Before execution of a buffer mode transfer of data, the program must perform the following steps:

1. Activate the channel to be used for the information transfer.
2. Load the channel's index register with the data control word. (The lower and upper halves of the data control word contain the beginning and ending addresses of the section of core storage involved in the transfer.)
3. Send the proper Function Word to the UNISERVO Control Unit.

Steps 1 and 2 above are accomplished with one of the Initiate Buffer instruction: 73, 74, 75, or 76, and step 3 is performed by the Enter External Function instruction, 13.

Data is then transferred between Computer core storage and the UNISERVO Unit without main program intervention. When a word is transferred to or from storage, 1 is added automatically to the lower half of the control word. The data transfer is terminated when:

- The Computer determines that the upper and lower halves of the control word are equal.
- A time lapse of 240 microseconds occurs between words in a write operation.
- There is an absence of data from the tape being read for 250 microseconds (end-of-block).
- The Terminate instruction is executed.

### WORD ARRANGEMENT

The Magnetic Tape Subsystem accommodates four types of Computer input-output words. They are the Function Word, Data Word, Identifier Word, and Status Word. These words are explained and illustrated in the following paragraphs.

#### Function Word

The Function Word designates the operation to be performed by the Magnetic Tape Subsystem. It is arranged in groups of 6-bit characters as follows:

FC			U
29	24 23	18 17	12 11
			0

The six most significant bit positions (29 through 24) of the Function Word are the function code, *FC*. The function code specifies the actual operation to be performed by the Magnetic Tape Subsystem.

Bit positions 11 through 0 of the Function Word contain the UNISERVO select bits. These *U* or master bits designate which UNISERVO Unit is to be used for the operation specified by the function code.

### Data Word

The 490 Data Word is arranged in five groups of 6-bit characters. When it is written or read with the tape moving in the forward direction, the first character consists of bits 29 through 24. The other characters consist of bits 23 through 18, and so on.

When the Data Word is read with the tape moving in the backward direction, the characters appear in the reverse order. The first character consists of bits 0 through 5. The other characters consist of bits 6 through 11, and so on. However, the inverted character sequence resulting from a backward read is reversed by the Channel Synchronizer-Control Unit and appears as:

29	24	23	18	17	12	11	6	5	0

### Identifier Word

The Identifier Word is a Computer output word that immediately follows a Search-Read Function Word. It can be in any bit configuration (below). It is transmitted to the Magnetic Tape Subsystem accompanied by an External Function signal. The Identifier Word characters are sequentially compared with the characters read from the first word of each block until the appropriate find is accomplished.

29	24	23	18	17	12	11	6	5	0

### Status Word

The Status Word is sent by the Magnetic Tape Subsystem into the Computer whenever error or status information is to be transmitted. A Status Word is arranged in 6-bit character groups.

The status code, *SC*, for the Magnetic Tape Subsystem is contained in the most significant 4-bits of the Status Word. All other bits in the Status Word are not used. They are transmitted to the Computer as random information or binary 0's.

When the Magnetic Tape Subsystem detects erroneous information at the end of a block, it transmits an External Interrupt signal to the Computer, which in turn initiates a normal input transfer of the Status Word

SC											
29	26	25	24	23	18	17	12	11	6	5	0

## FUNCTION REPERTOIRE

Operation of the UNISERVO Units depends on the type of Function Word sent by the Computer. A list of the instruction words contained in the upper 6 bits of the Function Word appears on page 4-3.

### WRITE FUNCTION

The Magnetic Tape Subsystem can be programmed to *write forward one block at 250 characters per inch* or to *write forward one block at 125 characters per inch*, either with or without interrupt.

#### Write Function Operation

To write (record) on a tape, the program issues one of the Write instructions.

The Channel Synchronizer-Control Unit interprets the Function Word, selects the UNISERVO Unit to be written on, prepares the selected UNISERVO Unit so that it will write in the specified manner when it receives a Data Word, and sends a ready pulse indicating that it is ready to receive the first Data Word.

The Channel Synchronizer-Control Unit receives the data characters, generates a parity bit and a sprocket bit, adds these bits to each character, and causes the character to be written on the tape. Parity is based on an odd number of 1's in a character.

Because data is written on the tape in the form of blocks, the above procedure is repeated until the end of the first block. A new function must be issued for each block to be written.

TABLE 1. INSTRUCTION WORD LIST

FUNCTION CODE		DESCRIPTION
Octal	Binary	
01	000001	<b>Output (type 1)</b> Write one block on magnetic tape at 12.5 kc* in RRU format.
02	000010	<b>Output (type 2)</b> Write one block on magnetic tape at 25 kc in RRU format.
11	001001	<b>Output (type 4)</b> Write one block on magnetic tape at 12.5 kc in RRU format, then send an External Interrupt signal to the Computer.
12	001010	<b>Output (type 5)</b> Write one block on magnetic tape at 25 kc in RRU format, then send an External Interrupt to the Computer.
20	010000	<b>Reposition UNISERVO Unit (type 1)</b> Rewind the magnetic tape on the tape transport.
21	010001	<b>Reposition UNISERVO Unit (type 2)</b> Rewind the magnetic tape on the tape transport with interlock against further functions.
23	010011	<b>Terminate</b>
30	011000	<b>Reposition UNISERVO Unit (type 3)</b> Rewind the magnetic tape on the tape transport. Send an External Interrupt to the Computer as soon as the <u>rewind has started.</u>
31	011001	<b>Reposition UNISERVO Unit (type 4)</b> Rewind the magnetic tape on the tape transport with interlock against further functions. <u>Send an External Interrupt to the Computer as soon as the rewind has started.</u>
33	011011	<b>Terminate with External Interrupt</b>
40	100000	<b>Automatic Bootstrap (type 1)</b> This function will override any function in progress. Rewind the magnetic tape; then read forward at normal gain from a specially selected UNISERVO Unit.

\* Thousands of characters per second.

TABLE 1. INSTRUCTION WORD LIST (Cont.)

FUNCTION CODE		DESCRIPTION
Octal	Binary	
41	100001	<b>Input (type 1)</b> Read forward on magnetic tape one block at low gain.
42	100010	<b>Input (type 2)</b> Read forward on magnetic tape one block at normal gain.
43	100011	<b>Input (type 3)</b> Read forward on magnetic tape one block at high gain.
45	100101	<b>Search-Read (type 1)</b> Search the tape at low gain for the first word of the block; when a find is made read the block containing that word.
46	100110	<b>Search-Read (type 2)</b> Search the tape at normal gain for the first word of the block; when a find is made read the block containing that word.
47	100111	<b>Search-Read (type 3)</b> Search the tape at high gain for the first word of the block; when a find is made read the block containing that word.
50	101000	<b>Automatic Bootstrap (type 2)</b> This function will override any function in progress. Rewind magnetic tape, then read forward at normal gain from a specially selected UNISERVO Unit. When the function is completed send an External Interrupt to the Computer.
51	101001	<b>Input (type 4)</b> Read forward on magnetic tape one block at low gain; then send an External Interrupt to the Computer.
52	101010	<b>Input (type 5)</b> Read forward on magnetic tape one block at normal gain. When the function is completed send an External Interrupt to the Computer.
53	101011	<b>Input (type 6)</b> Read forward on magnetic tape one block at high gain. When the function is completed send an External Interrupt to the Computer.
55	101101	<b>Search-Read (type 4)</b> Search tape at low gain for the first word of the block; when a find is made read the block containing that word at low gain. When the function is completed send an External Interrupt to the Computer.

TABLE 1. INSTRUCTION WORD LIST (Cont.)

FUNCTION CODE		DESCRIPTION
Octal	Binary	
56	101110	<b>Search-Read (type 5)</b> Search tape at normal gain for the first word of the block; when a find is made read the block containing that word at normal gain. When the function is completed send an External Interrupt to the Computer.
57	101111	<b>Search-Read (type 6)</b> Search tape at high gain for the first word of the block; when a find is made read the block containing that word at high gain. When the function is completed send an External Interrupt to the Computer.
61	110001	<b>Input (type 7)</b> Read the magnetic tape backward at low gain.
62	110010	<b>Input (type 8)</b> Read the magnetic tape backward at normal gain.
63	110011	<b>Input (type 9)</b> Read the magnetic tape backward at high gain.
65	110101	<b>Search-Read (type 7)</b> Search-Read on magnetic tape (backward) at low gain. <i>Looks AT FIRST IN WHICH IS LAST out</i>
66	110110	<b>Search-Read (type 8)</b> Search-Read on magnetic tape (backward) at normal gain.
67	110111	<b>Search-Read (type 9)</b> Search-Read on magnetic tape (backward) at high gain.
71	111001	<b>Input (type 10)</b> Read the magnetic tape backward at low gain. When the function is completed send an External Interrupt to the Computer.
72	111010	<b>Input (type 11)</b> Read the magnetic tape backward at normal gain. When the function is completed send an External Interrupt to the Computer.
73	111011	<b>Input (type 12)</b> Read the magnetic tape backward at high gain. When the function is completed send an External Interrupt to the Computer.
75	111101	<b>Search-Read (type 8)</b> Search-Read the magnetic tape backward at low gain. When the function is completed send an External Interrupt to the Computer.
76	111110	<b>Search-Read (type 9)</b> Search-Read the magnetic tape backward at normal gain. When function is completed send an External Interrupt to the Computer.
77	111111	<b>Search-Read (type 10)</b> Search-Read the magnetic tape backward at high gain. When the function is completed send an External Interrupt to the Computer.

## Write Function Conditions

Conditions that may occur during a write function are indicated by an External Interrupt (whether requested or not). They are as follows:

- Channel Synchronizer Sequence Error
- Channel Synchronizer Character-Count Error
- Control Unit Character-Count Error
- Illegal Function Code
- Illegal Select
- Interlock Fault
- Normal Answer

## Write Function Termination

The Write Function Word must be followed by at least one Data Word. Each Data Word to be written in a block must be received by the Channel Synchronizer-Control Unit within 200 microseconds or less at 25 kc. or within 400 microseconds or less at 12.5kc. Otherwise the Channel Synchronizer-Control Unit will terminate the block and effect a normal stop.

Data received after a termination, unless preceded by a new Function Word, will be considered a channel synchronizer sequence error and will not be written.

A new Write Function Word must be issued for each block to be written. The new Write Function Word and the first Data Word must be received by the Channel Synchronizer-Control Unit within 2 milliseconds after termination of the previous block. Otherwise the tape movement will be stopped and a delay will ensue.

## READ FUNCTION

The Magnetic Tape Subsystem can be programmed to read in either the forward or backward direction: at high, low, or normal gain.

### Read Function Operation

To read from a tape, the program must issue a read function for the reading of each block, but the Computer may stop accepting data at any point within the block, or accept none of the information. This allows partial reads and move operations.

The data transfer rate is 200 microseconds per word at the 25 kc rate. If a Data Word is not accepted by the Computer before the reading of the next word is completed, the second word and all of the succeeding words will be read from the tape but will not be available to the Computer. The tape will be positioned at the end of the block.

## Read Function Errors

Errors that may occur during a read function:

- Channel Synchronizer Sequence Error
- Channel Synchronizer Character-Count Error
- Control Unit Character-Count Error
- Control Unit Sequence Error
- Parity Error
- Illegal Function Code
- Illegal Select
- Interlock Fault
- End of File
- Normal Answer

## Read Function Termination

During a read function, detection circuits in the control unit are activated when the first data character is read. After this time, if there is an absence of data from the tape for 250 microseconds, the Control Unit develops an end-of-block pulse and initiates an action to stop the UNISERVO Unit.

## SEARCH-READ FUNCTION

The Magnetic Tape Subsystem can be programmed to search (read) the first word of each block on the tape until it finds a word that is identical to an Identifier Word. This search may be made with the tape moving in the forward or backward direction; at high, low, or normal gain. When a find is made, the Data Words in the block will be read in the normal manner.

### Search-Read Function Operation

The function that specifies a search-read must be followed by an Identifier Word, which may be any configuration of bits, subject to programming conventions.

The search-read function includes all the characteristics of the read function, coupled with a search operation on the first word of a block.

The search portion of the search-read operation compares the first word of the block with an Identifier Word. If a find is not made, the Channel Synchronizer-Control Unit moves on to the next block and compares the first word of that block with the Identifier Word. This process is continued until a find is made, the search is terminated, or the end of file occurs.

When a find is made, the Channel Synchronizer-Control Unit goes into the read portion of the search-read operation, which is the same as a normal read-operation. The read operation begins with the Identifier Word and continues until the end of the block.

If the search-read function specifies backward movement of the tape, the last word of the block (first word to be read) is the Identifier Word. When a find is made, the Channel Synchronizer-Control Unit executes a read-backward command for the block containing the Identifier Word.

#### **Search-Read Function Termination**

During the search portion of the search-read function, an error will stop the search at the end of the block.

A terminate function that is programmed during the search portion of the search-read function will stop the search at the end of the block.

During the read portion of the search-read function, detection circuits in the Channel Synchronizer-Control Unit are activated when the first character is read. After this time, if there is an absence of data from the tape for 250 milliseconds, the unit develops an end of block pulse and stops the UNISERVO Unit. An end of file will also stop any function in progress.

#### **REWIND**

The initiation of a rewind function is a logical operation. The function requires no further control after the operation is initiated. The UNISERVO Unit is locked out from any further operation until the rewind is completed. If interlock is specified, this lockout will remain in effect until manually released.

If rewind with interrupt is specified, the interrupt will come as soon as the rewind is initiated. The time necessary to initiate the first rewind is 35 milliseconds. Additional rewinds given to the channel, immediately following the first, will take 35 milliseconds each. An additional 620 milliseconds are required if the tape direction must be reversed.

#### **TERMINATE FUNCTION**

This instruction tells the Channel Synchronizer-Control Unit to stop at the end of the block or upon completion of the rewind. This instruction is useful only in the search portion of a search-read instruction. The read and write instructions are block instructions. A read will be completed, even if the Computer has stopped accepting data. Therefore the terminate will have no effect on block or rewind instructions.

#### **EXTERNAL INTERRUPTS**

##### **Normal Answer Interrupt**

If the write, read, or read portion of the search-read function requires an External Interrupt upon completion, the interrupt will be given at the end of the block. The first 4 bits of the Status Word will contain the code 1000 for a normal answer interrupt.

If the rewind function requires an External Interrupt, the interrupt will be given after the rewind has been initiated.

An error interrupt will replace the normal answer interrupt if an error occurs in the operation.

#### **ERRORS**

Errors are indicated by an External Interrupt, whether requested or not. An error interrupt will replace the normal answer interrupt if an error occurs in the operation.

##### **Parity Error**

Parity is generated within the Channel Synchronizer-Control Unit. Parity errors occur only during the read or search-read operations, not during a write operation.

Parity is checked on the reading of each character, but the entire block is read normally. If a character does not have odd parity, the Channel Synchronizer-Control Unit develops a parity error interrupt at the end of the block. There is no indication of the specific word that contains the error. Also, more than one parity error may have occurred during the read operation.

Parity errors can also occur during a search-read operation. The parity error interrupt is given at the end of the block, as it is during a normal read

operation. However, the error(s) may have occurred in either the search or read portion of the operation. If only one word was read into the Computer, the parity error occurred in the search word. If more than one word was read into the Computer, the parity error occurred in the find block.

The upper 4 bits of the Status Word will contain the code 1100 for a parity error interrupt.

#### **Character-Count Error**

The character-count error occurs when an integral number of characters (modulo 5) is not available to read. On a read or search-read operation, the character-count error will occur as the last word of a block. If an attempt is made to read fewer than 5 characters per word, the last data transfer will not be read into the Computer and the block will be terminated.

This error, like the parity error, can also occur during the search or the read portion of the search-read operation. The character-count interrupt will be sent to the Computer when an error occurs. The upper 4 bits of the Status Word will contain the code 1110 for a character-count interrupt.

#### **Illegal Function Code Error**

The illegal function code error occurs when the Computer programs the Channel Synchronizer-Control Unit to carry out an operation that it is not capable of doing. No operation is initiated when this type of error occurs. If both illegal function code and illegal address occur, it will be a function code error.

The upper 4 bits of the Status Word will contain the code 1010 for an illegal function code.

#### **Illegal Address or Uniservo Select Error**

This error results when the Computer requests the Channel Synchronizer-Control Unit to operate none, or more than one UNISERVO Unit.

The upper 4 bits of the Status Word will contain the code 1011 for an illegal address or UNISERVO Unit select error.

#### **Interlock Error**

An interlock error occurs if a UNISERVO address is manually assigned to more than one UNISERVO Unit. The upper 4 bits of the Status Word will be 1111.

#### **End of File**

The end of file is not an error. However it is discussed in this section. The end of file occurs during a read or a search-read function. If no data is read for 35 milliseconds, the Channel Synchronizer-Control Unit assumes all data on that tape file has been read, and sends an External Interrupt signal to the Computer, indicating that it has reached an end of file. The upper 4 bits of the Status Word will be 0111. The programmed operation at this point may be a rewind operation.

#### **End of Tape Interrupt**

The end of the tape is detected by the UNISERVO Unit during all read, search-read, and write functions. The upper 4 bits of the Status Word will be 1111.

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