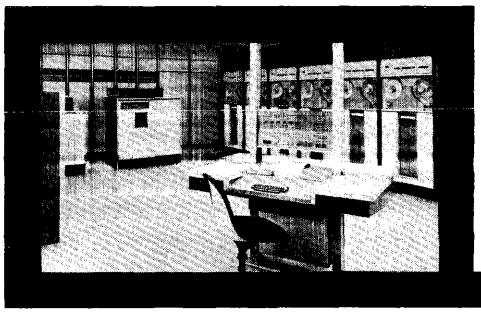
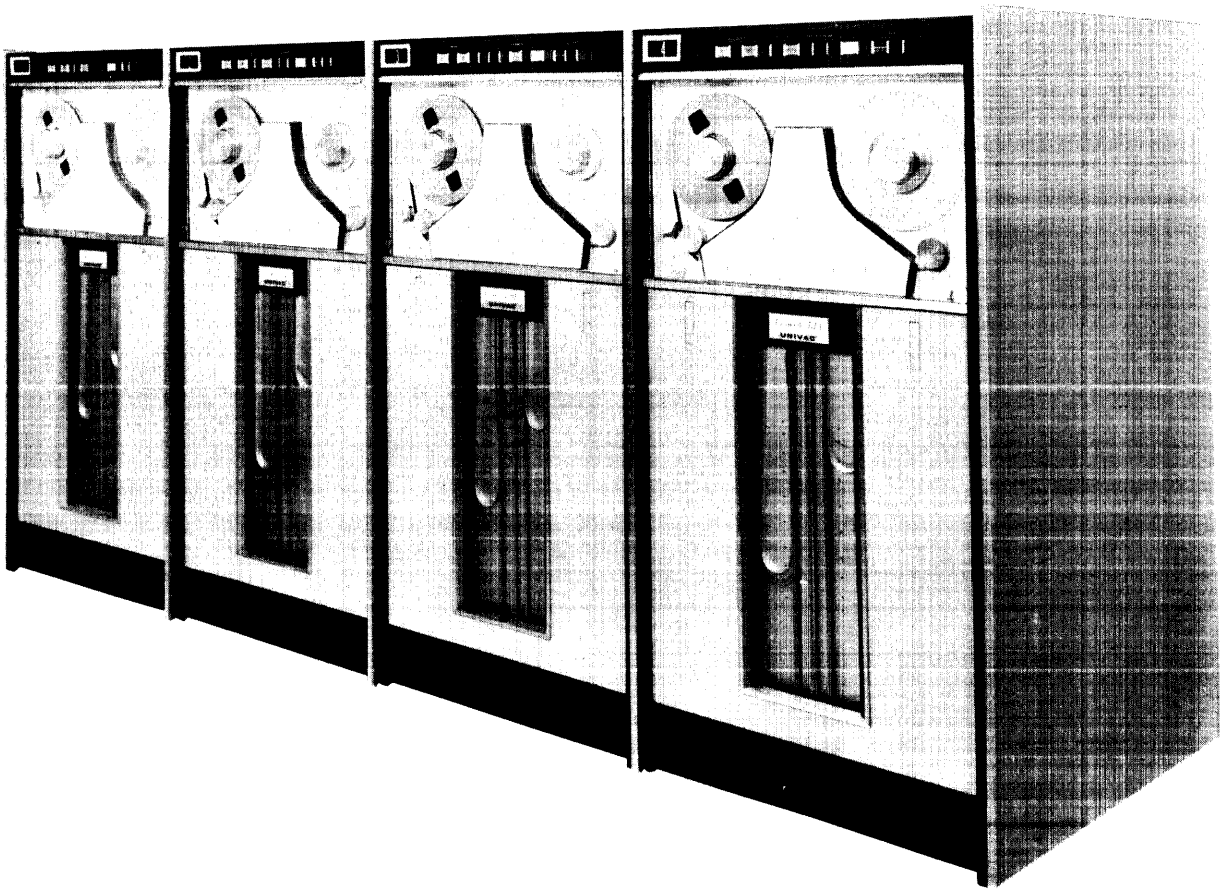
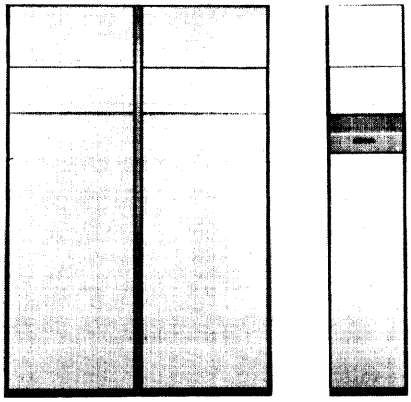


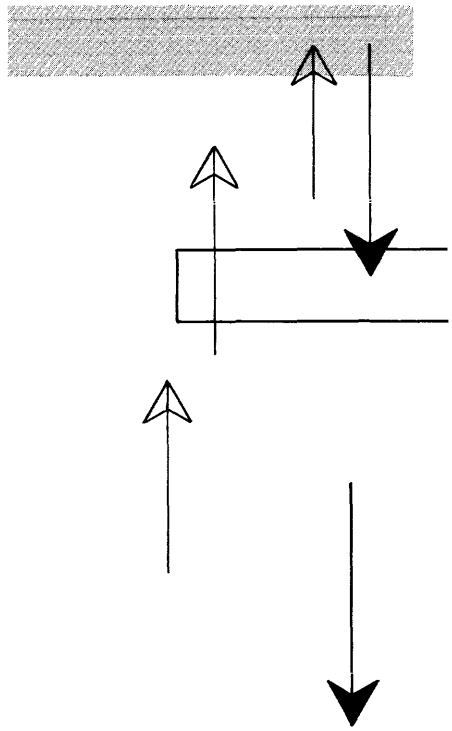
UNIVAC 1107 THIN-FILM MEMORY COMPUTER

UNISERVO IIIA MAGNETIC TAPE SUBSYSTEM

TECHNICAL BULLETIN


UNIVAC





CONTENTS

INTRODUCTION

The UNISERVO* IIIA Magnetic Tape Subsystem is the newest and fastest member of the growing family of magnetic tape subsystems available for theUNIVAC®1107 Thin-Film Memory Computer System.

In this bulletin are shown some of the advanced features which contribute to this speed and superior performance. The capabilities of the subsystem are listed, together with some of the engineering and circuitry features which provide these capabilities. The repertoire of instructions is detailed, and basic programming examples are included.

Your familiarity with the UNISERVO IIIA subsystem will add much to your understanding of the many data-handling possibilities of the UNIVAC 1107 Thin-Film Memory Computer.

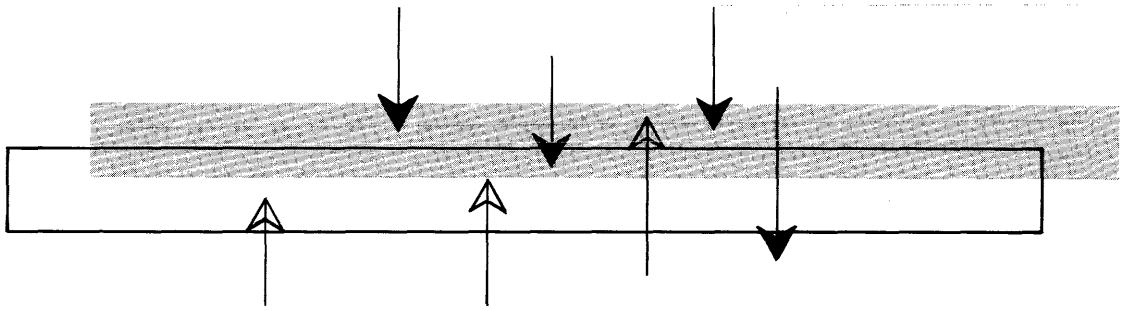
*UNISERVO: Trademark, Sperry-Rand Corporation

The UNISERVO IIIA Magnetic Tape Subsystem provides storage of tremendous quantities of rapidly-accessible data, in a medium easily transported and easily revised. A subsystem may comprise two to 16 UNISERVO tape units, communicating with one or two computer systems; it may be multiplexed (if desired) through two control units for simultaneous two-unit communication.

FEATURES

Capacity Each tape unit uses 3500 feet of a 3600-foot reel of one-mil-thick plastic tape. Since this is thinner and therefore longer than previously-used 1.5-mil tape, the storage capacity is automatically increased by one-half. Then, recording density of 1000 frames per inch is greater than that of earlier units. Moreover, a computer word can be contained in only five tape frames instead of requiring six frames, which permits the storage of one-fifth more equivalent data on a given length of tape. All these factors combine to provide more capacity per reel than ever before.

Accessibility Rapid accessibility is possible because of such features as the high rewind speed (over 300 inches per second), the fact that tape can be read either in the forward or backward direction, and the versatility of the repertoire of instructions. For example, *Search* may be commanded in either direction, and if *Masked Search* is commanded, any portion of an Identifier Word may be selected; the *Reposition Read Forward* instruction allows the skipping of a block of data before beginning to read; and control-switching commands allow access by either of two computer systems interconnected with the subsystem.



Dependability The IIIA subsystem has several built-in trouble-reducing features. Special circuitry automatically compensates for tape skew while reading. Parity is checked immediately after writing, so that bad-spot detection circuitry may instantly void the writing and call for a programmed re-write of the bad data. These protections do not require any operator intervention. An added protection against accidental destruction of written data is the *"Write Enable"* ring which must be attached to a tape reel to permit the writing of any new data on that tape. A permanent tape leader facilitates easy, trouble-free tape mounting.

Reliability Mechanically, the UNISERVO IIIA tape unit is of advanced design. The improved tape transport mechanism, which features a vacuum capstan to "clutch" the tape (reducing slippage and tape stretching), brings start and stop time down to three milliseconds (to within 2% of steady speed). Unitized tape transport panel construction, independent of the main cabinet frame, assures greater accuracy and stability of the tape path alignment. Closing of the tape unit door automatically moves a newly-mounted tape to its Load Point, ready for use.

The IIIA subsystem allows more data to be handled, faster, more flexibly, and with less manipulation than in previous tape subsystems.

The Subsystem

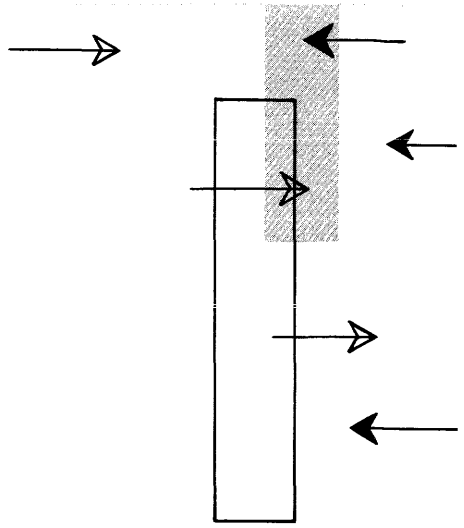
Appearance Each UNISERVO IIIA Magnetic Tape Subsystem has from four to 19 cabinets, depending upon the number of magnetic tape handlers assigned to the subsystem. From two to 16 UNISERVO tape handlers, one or two control cabinets, and a power supply constitute each subsystem. The control cabinet and the power supply contain adequate circuitry to drive and control any number of tape units, from two to 16. The cabinets match in style and decor the others of the UNIVAC 1107 Computer System.

The control cabinet has indicators and switches across its upper panel for operator control and monitoring. Lower down behind a door is a secondary panel for UNISERVO unit bootstrap assignment and for bootstrap disablement; beneath this is a patchboard for tape unit logical assignment. At the rear, behind a door, is the maintenance panel for complete circuitry monitoring and for maintenance analysis.

Each UNISERVO unit's hubs and leader for mounting and demounting tape reels are accessible behind a transparent front door. The actual read/write and erase heads are behind a protective housing attached to the front panel. Above the transparent door are the switches and indicators for operator control and monitoring. The tape transport panel is manufactured as a unit, independent of the main cabinet frame; this fact assures greater alignment accuracy in the tape path. Vacuum at the tape capstan and in tape loop chambers enables fast, accurate tape motion. The vacuum at the capstan "clutches" the tape to prevent slippage and stretching. The tape loop vacuum chambers assure even tension and proper alignment of the tape passing over the capstan. Tape accelerates or decelerates within 3 milliseconds. The supply hub has interlock circuitry to sense the present of a Write Enable ring; this must be physically attached to the tape reel to permit writing.

Conditioned air enters the cabinets through floor vents and is exhausted at the tops. Inter-cabinet cables are carried through the "trellis" cable tray above the UNISERVO cabinets.

Purpose Each UNISERVO unit reads or writes binary data on nine channels across the width of the half-inch plastic tape, at a density of



1000 frames per inch. This density is possible because of the pulse phase method of recording.

Upon command of the Computer (through subsystem control circuitry), an individual UNISERVO unit will write specified data on tape (forward), read specified data from tape (forward or backward), or search for a particular Identifier Word and then read a given amount of data (forward or backward). In addition, positioning commands—such as rewind—also direct the UNISERVO units. Read and write speed is 100 inches per second; rewind speed is over 300 inches per second.

The UNISERVO IIIA Control cabinet contains circuitry for specialized control of UNISERVO units, as well as 1107 channel synchronizer circuitry. The tape control circuitry includes the special write compare circuits for the pulse phase modulation method, circuitry to compensate for tape skew while reading, parity generating and detection circuitry, bad spot control circuitry, and error-signalling circuitry. The tape control circuitry is conditioned for its specific operations by the circuitry which decodes and interprets the Function Word sent by the Computer.

The Channel Synchronizer disassembles 36-bit computer words into frames of eight data bits for transmission to the tape unit; it assembles the tape characters into 36-bit words for transmission to the Computer; and it exchanges control signals with the Computer to synchronize subsystem and computer operations.

Subsystem instructions are detailed in Appendix A. Each Instruction Word in the repertoire may be programmed with or without an interrupt to the Computer when the instruction is completed normally.

Options A basic arrangement for a subsystem has one channel synchronizer/tape control cabinet connected to one computer input/output channel controlling from two to 16 tape units.
However, other system applications are possible by using optional equipment. They are detailed in Appendix D.

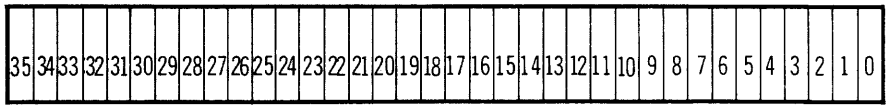
DATA FORMAT

The UNISERVO IIIA subsystem has eight data channels or tracks and one parity channel for each frame on the magnetic tape. The 36-bit computer words are normally disassembled into five 8-bit frames (with "0" fill as needed).

TRACK	TAPE MOVEMENT				
1	0	8	16	24	30
2	2	10	18	26	32
3	4	12	20	28	34
4	6	14	22	X	X
5	P	P	P	P	P
6	7	15	23	X	X
7	1	9	17	25	31
8	3	11	19	27	33
9	5	13	21	29	35

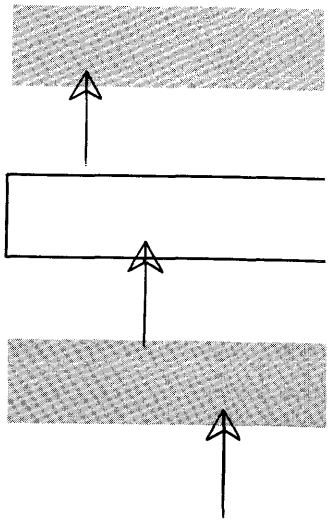
DIGITS REPRESENT BIT POSITIONS

P = PARITY BIT
X = ZERO FILL



REGISTER FORMAT

A second format option is shown in Appendix D. When a particular format is chosen for disassembly, the same format is necessarily chosen for assembly of computer words during reading.



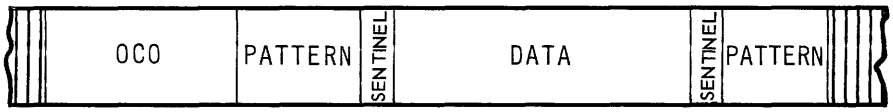
The parity channel contains a "1" when necessary to provide even parity in the count of "1"s in the frame of which it is a part.

Blocks may be of any length, limited only by the physical length of the tape, capacity of computer storage, and other programming factors. As each block is written, the subsystem "surrounds" it by writing a specific pattern and sentinel both before and after the data. This alerts reading circuitry to the beginning and end of data, whether the tape is read forward or backward.

In addition, other special patterns (see illustrations) indicate to the Computer whether or not the block was written without error. The Computer program can then ignore the read-in of an incorrect block or the subsystem can skip an incorrect block (depending upon the direction of tape read).

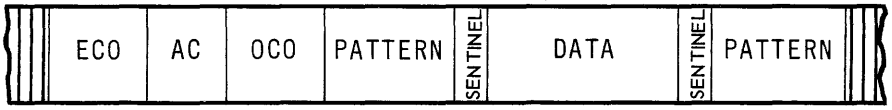
All writing is read back by a read head adjacent to the write head, at which time it is checked for parity-correctness, correct frame count, and skew. This allows detection of tape bad spots or writing errors.

NORMALLY-WRITTEN BLOCK



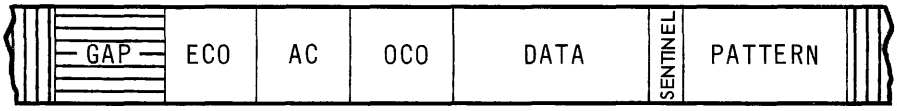
OCO: 0's IN ODD CHANNELS ONLY, 223 FRAMES, OCO PRECEDING AN ERASED TAPE GAP INDICATES A NORMALLY WRITTEN BLOCK.

COMPLETELY-WRITTEN BLOCK WITH FRAME-COUNT OR OTHER BLOCK ERROR



AC: 0's IN ALL CHANNELS, 260 FRAMES.
ECO: 0's IN EVEN CHANNELS, 260 FRAMES. ECO PRECEDING AN ERASED TAPE GAP (IN FORWARD DIRECTION) INDICATES AN ERROR.

PARTIALLY-WRITTEN BLOCK WITH PARITY OR BAD SPOT ERROR



OCO WITHOUT PATTERN AND SENTINEL INDICATES ERROR

PROGRAMMING

The control circuitry of the UNIVAC 1107 Computer transmits Function Words to the UNISERVO IIIA subsystem to establish the function for a given instruction. The subsystem reports normal completion or other conditions, using Status Words.

Function Words Functions performed by the IIIA subsystem may be grouped as follows: (each may be programmed with or without a computer interrupt at completion)

Basic Functions

Write (forward only)
Read (forward or backward)
Search (forward or backward, with or without masking)
Reposition Read (forward or backward)

Erasure

Contingency Write
Write File Separator

Special Functions

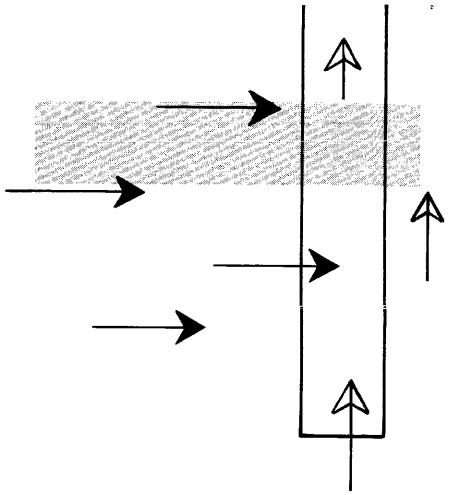
Rewind (to Unload Point with Interlock or to Load Point)
Terminate
Bootstrap

Dual-Computer (Appendix D)

Clear, Local
Clear, Remote
Request Availability

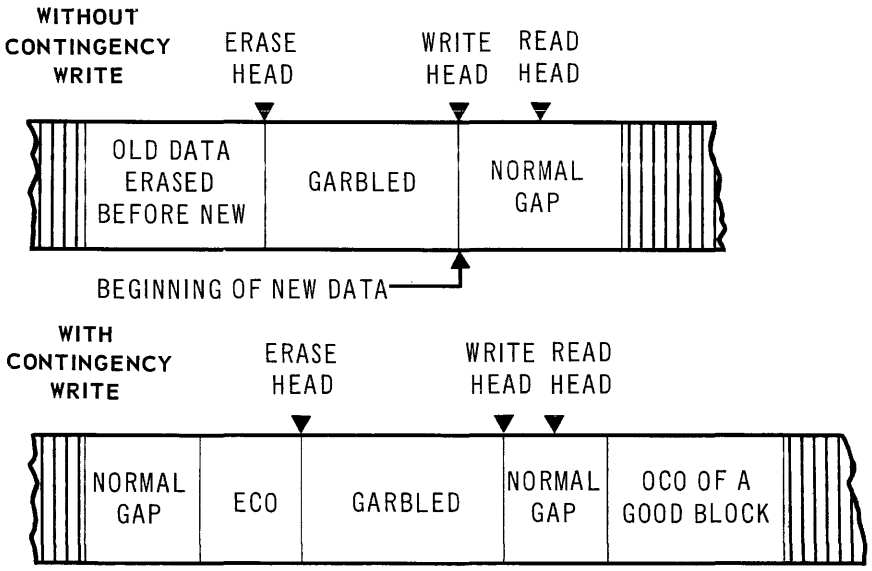
Most of these functions are easily analyzed by their functional names; however, four are explained below:

Reposition Read Forward directs the subsystem to skip the block of data which it would normally read next, then to go on to the following block and read it. This is used to recover from an error caused by a block which was apparently written and checked without error detection. It permits skipping the block that cannot be read without error detection and reading the next block.



Reposition Read Backwards is used in case an error is detected in a block with a normal ending pattern and the erased tape gap following the troublesome block is smaller than normal, thereby causing the tape to stop with the read head over the next block. It is used to ignore any initial recording encountered before an erased tape gap is encountered and read the troublesome block in the backward direction.

Contingency Write is used when updating a portion of an existing tape. Because the erase head is approximately 1.8 inches ahead of the read/write, a normal *Write* instruction would be unable to erase the first 1.8 inches of old data in the block to be updated. New data would be written on top of the old, resulting in a garble for the first 1.8 inches. The *Contingency Write* instruction writes 2.5 inches of ECO. The first 1.8 inches of this is on top of the old data, and the last 0.7 inches is on erased tape. A normal gap should precede and follow the 2.5 inches of ECO recording.



Write File Separator causes tape to move past the erase head until 2.5 inches of tape have been erased. The subsystem, when reading, recognizes this gap as the end of a file. A given tape may contain as many different files of data as desired, limited only by the physical capacity of the tape.

Masked Search allows search Identifier Words which are other than normal 36-bit configurations. Masking specifies what bit positions in the Identifier Word will be used for a specific search.

The format of Function Words assigns the highest-order six bits as the function code, and the lowest-order four bits as the servo-select code; the remainder of the word is ignored.

The complete repertoire of UNISERVO IIIA Function Words is detailed in Appendix A. Programming examples are shown in Appendix B.

Communication Sequence When the subsystem is not active but is available to the Computer, it presents to the Computer an Output Data Request signal. When the Computer program is ready to establish communication with the subsystem, it sends the subsystem the appropriate Function Word on the output data lines, together with an External Function signal on a control line.

After the function has been established in the subsystem, the transmission of data begins, in the usual 1107 sequence:

OUTPUT (Computer to subsystem)

Each data word :
(1) Subsystem presents Output Data Request;
(2) Computer transmits Data Word and Output Acknowledge;

At end of sequence :
Subsystem transmits normal completion interrupt Status Word to Computer, if specified by the function word. In case an error or abnormal condition is detected during execution of a function, the subsystem transmits a special Status Word to the Computer even if the function word specified "without interrupt."

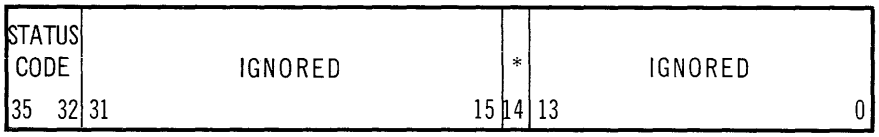
INPUT (Subsystem to Computer)

Each data word :
(1) Subsystem presents Input Data Request and Data Word;
(2) Computer transmits Input Acknowledge;

At end of sequence : Subsystem transmits normal completion interrupt Status Word to Computer if specified by the function word. In case an error or abnormal condition is detected during execution of a function, the subsystem transmits a special Status Word to the Computer even if the function word specified "without interrupt."

Status Words The subsystem notifies the Computer of conditions within the subsystem by means of Status Words. These words are generated to indicate either the normal completion of an instruction (if the Computer so commands) or an abnormal condition requiring Computer program or operator attention.

A Status Word is sent on the input data lines, in this format:



* A "1" BIT IN POSITION 14 IS THE END-OF-TAPE WARNING

Those codes which indicate abnormal conditions may be generally grouped relating to the equipment in which the problem exists:

Tape Unit	Control
Manual Intervention Required	Function Terminated
Maintenance Intervention Required	Illegal Function
Requested Servo Rewinding	Repeat Operation
End of File	Improperly-Written Block
Tape Marker Detected (simultaneous with End-of-Tape warning, bit 2^{14})	Frame Count Error
	Servo controlled by other Control Unit (Dual operation only)

While the names of most of the Status Words define their purposes, some clarification of the others is desirable.

Manual Intervention Required results only when the requested UNISERVO unit has an interlock set.

Maintenance Intervention Required. is generated by a UNISERVO signal malfunction.

Function Terminated is an abnormal programmed termination — before the functional sequence has been completed.

Repeat Operation is generated by one of five specific conditions:

(1) a loss of transfer synchronism during writing (Computer resumes sending data after subsystem stops writing) Status "A" (see below);

(2) a loss of transfer synchronism during reading (Computer resumes accepting data after "pile-up" loses data in subsystem) Status "B";

(3) a parity error during reading;

(4) a missed start sentinel;

(5) overskew.

Improperly-Written Block is generated by errors detected during write-check reading, and by the "bad ending" pattern during normal reading.

Only one Status Word is recognized and acted upon at any one time by the Computer. If two or more are generated simultaneously, the one with the highest priority is recognized, on the basis of this order:

Function Terminated	(Coded 64_8)
Illegal Function Code	(50_8)
Manual Intervention Required	(74_8)
*Servo Controlled by Other Control Unit	(14_8)
Requested Servo Rewinding	(10_8)
Maintenance Intervention Required	(30_8)
End of File	(34_8)
Repeat Operation (Status "A")	(60_8)
Improperly Written Block	(54_8)
Frame Count Error	(60_8)
Repeat Operation (Status "B")	(70_8)
Tape Marker Detected (also 2^{14} is "1")	(44_8)
Normal Completion	(40_8)

*Dual configuration only; see Appendix D.

Thus, the *Normal Completion* Status Word can be transmitted only if no other Status Word condition was generated.

Identifier Words When *Search* is ordered, an Identifier Word must be transmitted to the subsystem and stored there for comparison with the first word read from each block searched. The Identifier Word has no specified format; it may be in any configuration of 36 bits relevant to the program. Masked Search may be ordered, in which only specified bits of the Identifier Word are compared. A Mask Word is stored in the subsystem ahead of the Identifier Word; wherever a "1" appears in the Mask Word, it causes comparison between the corresponding bits of the Identifier Word and the first word, but a "0" in the Mask Word masks out (invalidates) comparison of the corresponding bits.

Bad Spot Detection When the tape surface is such that data cannot be written and read back satisfactorily, recovery is completely under Computer program control. No operator intervention is necessary. Bad spots are detected by a parity check of data just written, using the read head adjacent to the write head. If an error is detected, the writing of data stops and the error pattern is written: "0"s in the odd channels only (OCO), "0"s in all channels (AC), and "0"s in even channels only (ECO). If a parity error is detected in any one of the last 250 data frames written, the subsystem writes the usual ending sentinel pattern, then OCO, AC, and ECO.

Reading control circuitry in the subsystem monitors the ending pattern of each block before starting to read the next block. If a bad block has just been read, the presence of the ECO pattern indicates the bad block. The subsystem notifies the Computer, which then rejects the data from the bad block. The program will normally have called for a rewrite of the block, so the next block read is the correct version of the bad block. If the tape were being read backwards, the reverse would take place; the ECO indication would tell the subsystem that the block it had just read was correct, but the one it was starting to read should be skipped.

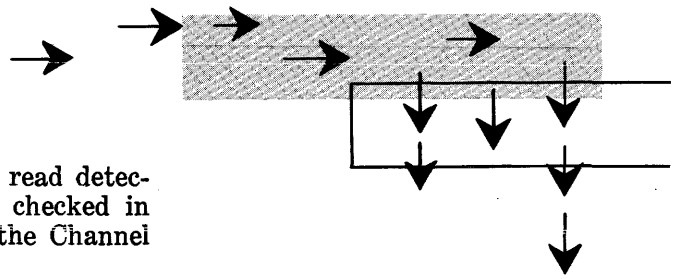
CIRCUITRY

Logic The basic circuitry logic of the UNISERVO IIIA subsystem is illustrated on page 16. A 36-bit Data Word is transmitted to the Channel Synchronizer assembly-disassembly registers by the computer, from where it is routed in 8-bit data frames through control circuitry to the tape write circuitry. In the other direction, 8-bit data frames are read from tape and routed through control circuitry to the Channel Synchronizer, where they are assembled into 36-bit words for transmission to the Computer.

A Function Word, transmitted first in any input/output sequence, is routed to the disassembly register in the Channel Synchronizer. From there, the significant bits are gated to tape control circuitry: the highest-order six bits to the function code register, and the lowest-order four bits to the UNISERVO select register. The highest-order six bits are also routed to control circuitry in the Channel Synchronizer. In both the Channel Synchronizer and the control circuitry, decoding of the function code enables the circuitry which performs that particular function.

If the function commanded is *Search*, the frames of the Identifier Word are transmitted, one at a time, from the assembly register to search comparison circuitry at the same time the corresponding frames of the word being read from tape are transmitted to the same comparison circuitry. Frames read from tape for search identifier comparison are not transmitted to the assembly register; only after a "find" occurs are the frames routed for transmittal to the computer. If a *Masked Search* is commanded, the Mask Word is stored in the disassembly register, ahead of the Identifier Word in the assembly register.

Write As frames are routed from the Channel Synchronizer disassembly register, they consist of eight bits. In control circuitry, the frame is checked for the number of "1"s and a ninth bit is added containing a "1" where necessary to make the parity even. Then, the frame is routed into Write Compare circuitry. There are two registers for write comparison; the second contains the character to be written on tape, and the first contains the character to be written after that. It is necessary for the circuitry to know what the following bit in each channel is in order to know whether the tape magnetic field must change polarity. (This is explained further under the heading of Recording Method, on page 18.) In addition to the data from the Computer, the patterns (for block endings, etc.) are generated within the control circuitry and routed to Write Compare circuitry.

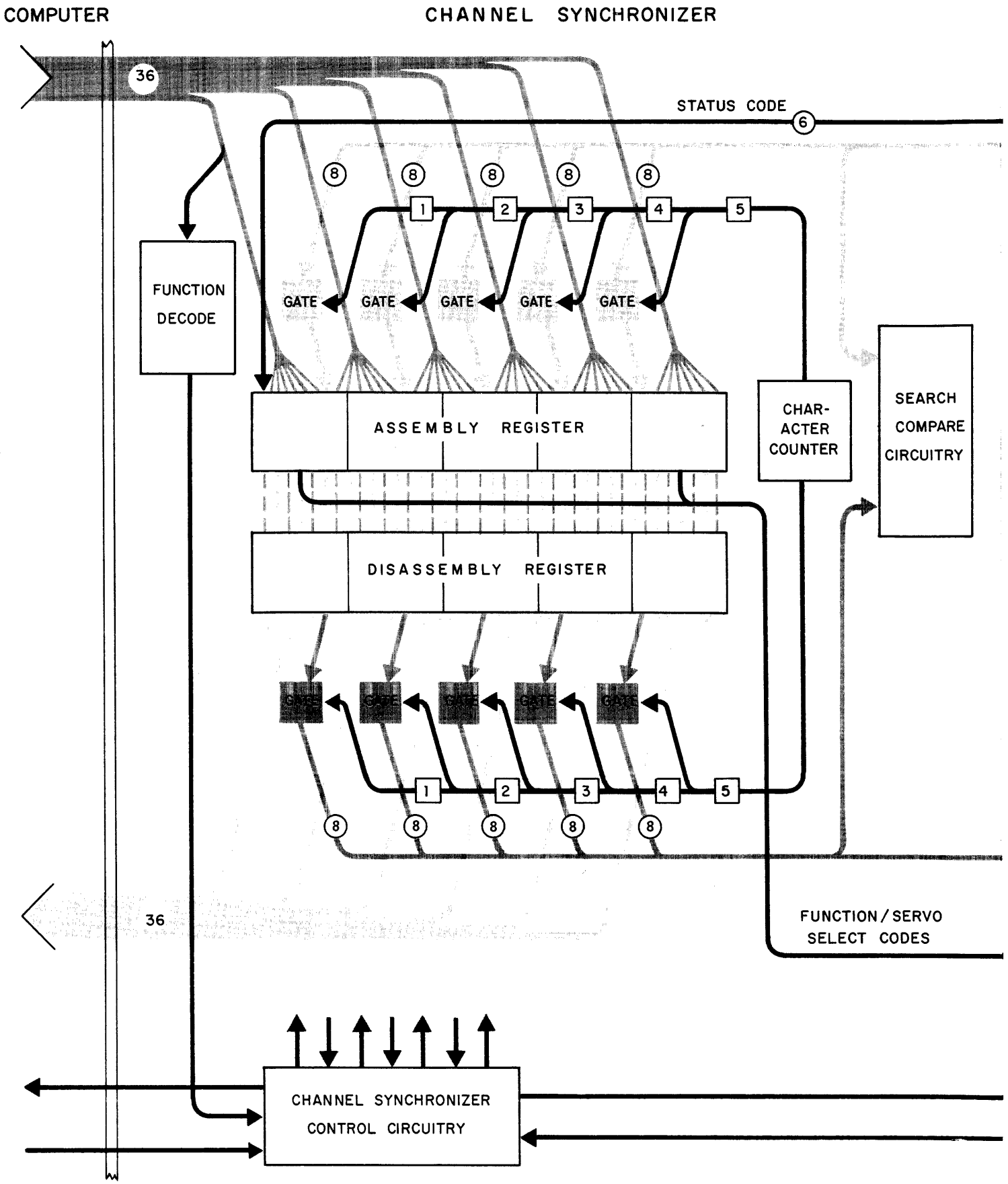


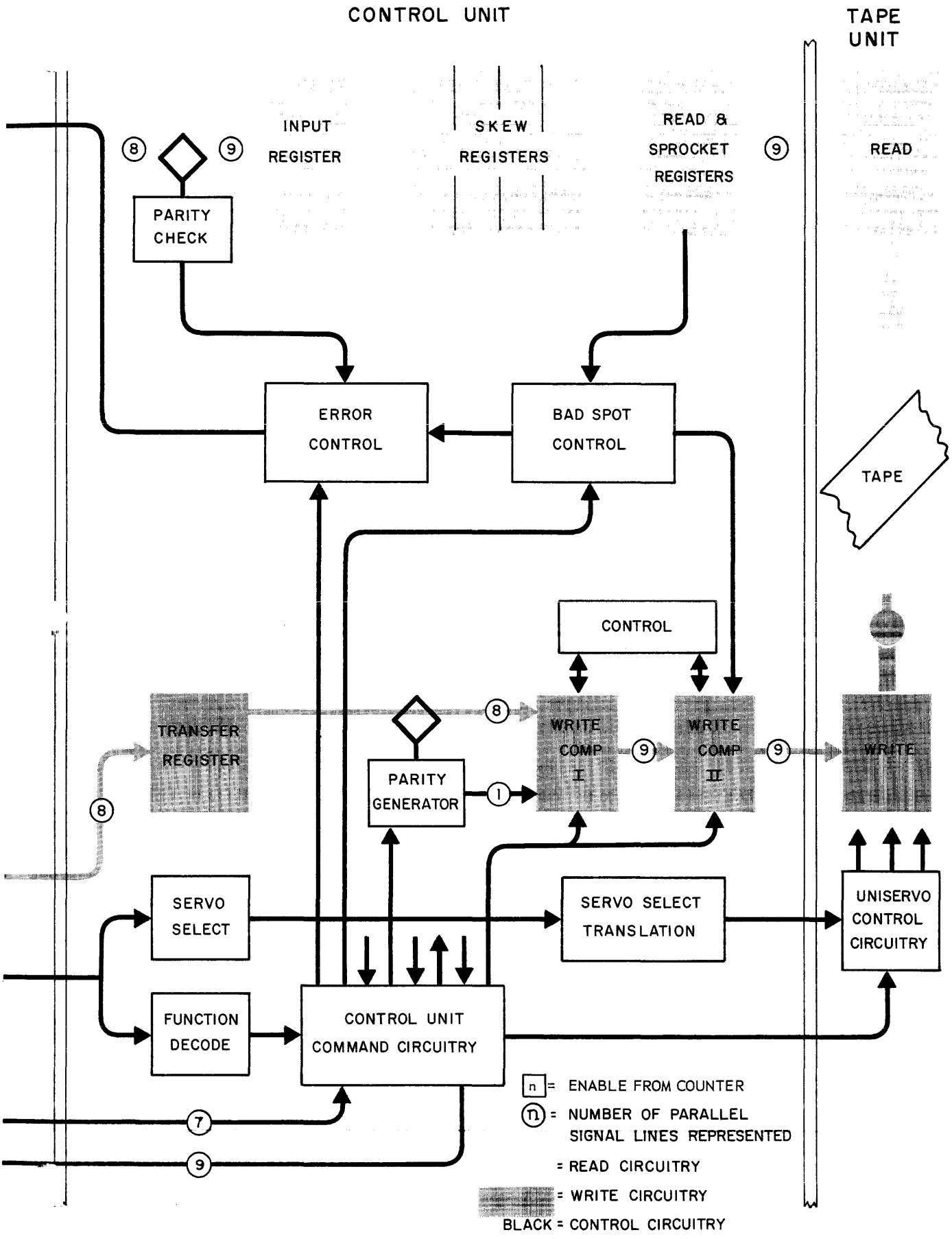
Read Characters read from the tape are registered in read detection circuitry, routed through skew detection circuitry, checked in input circuitry for parity correctness, and then sent to the Channel Synchronizer for assembly.

Four special registers compensate for any skew in the tape, if the skew does not exceed four frames in magnitude. The data frames thus "straightened" (when necessary) are checked for parity-correctness in the input register, then routed to the Channel Synchronizer. There, gated by the character counter, they are routed to the correct portion of the assembly register for transmission as the 36-bit word to the Computer.

Separately, the four highest-order bits of the assembly register receive the Status Word coding as generated in tape control error circuitry.

Search When *Search* is commanded, the 36-bit Identifier Word is retained in the assembly register until the search is completed. Then, as each frame of each tape word being checked is routed to the Channel Synchronizer, that character and the corresponding character of the Identifier Word are brought together in search comparison circuitry. They are compared, bit to bit; if there is any disparity, the search normally continues; if all characters of the words match exactly, control circuitry is notified that a "find" has occurred. This automatically begins a read of the number of words specified by the input access control word if the input mode is active.


COMPUTER
CHANNEL SYNCHRONIZER
36
STATUS CODE
6
8
1
2
3
4
5
FUNCTION DECODE
GATE
ASSEMBLY REGISTER
CHAR-ACTER COUNTER
SEARCH COMPARE CIRCUITRY
DISASSEMBLY REGISTER
FUNCTION / SERVO SELECT CODES
CHANNEL SYNCHRONIZER CONTROL CIRCUITRY


CONTROL UNIT
TAPE UNIT
INPUT REGISTER
SKEW REGISTERS
READ & SPROCKET REGISTERS
READ
8
9
PARITY CHECK
ERROR CONTROL
BAD SPOT CONTROL
TAPE
CONTROL
TRANSFER REGISTER
PARITY GENERATOR
1
WRITE COMP I
WRITE COMP II
WRITE
SERVO SELECT
SERVO SELECT TRANSLATION
UNISERVO CONTROL CIRCUITRY
FUNCTION DECODE
CONTROL UNIT COMMAND CIRCUITRY
7
n = ENABLE FROM COUNTER
n = NUMBER OF PARALLEL SIGNAL LINES REPRESENTED
= READ CIRCUITRY
= WRITE CIRCUITRY
BLACK = CONTROL CIRCUITRY

If *Masked Search* is commanded, the 36-bit Mask Word is stored in the disassembly register; each "1" bit in a Mask Word enables comparison of the corresponding bit positions of the Identifier Word and first word. Those bit positions in the Mask Word which contain a "0" bit are ignored in the comparison.

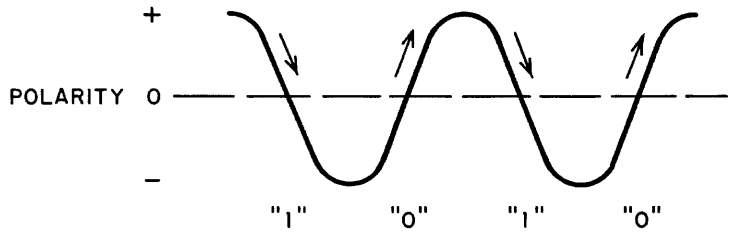
SKEW COMPENSATION Four special registers in the reading circuitry compensate for skew which may develop, up to four frames. These registers electronically "line up" the bits for a frame even though the bits may reach the tape read head at different times. The pattern-and-sentinel arrangement preceding the actual data make it possible for the reading circuitry to detect for each channel when the first actual data arrives. The effect of the skew registers is to hold the data bits for the first data frame and each subsequent data frame in the last skew register until all the bits of the frame are in that register.

The bits for each data frame will not be gated out of the last skew register until all channels of that frame have reached that register.

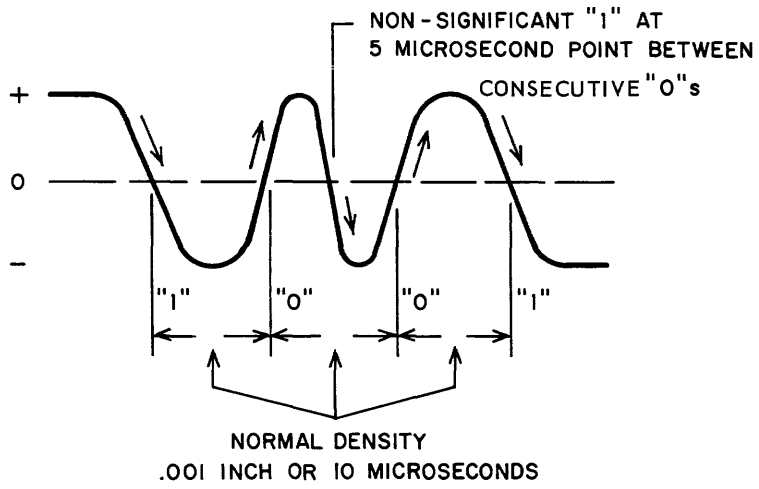
Recording Method The UNISERVO IIIA subsystem uses the "pulse phase" method of recording, which contributes to its high speed, density and reliability.

Earlier recording methods have included "return to zero", "return to bias", and "change-on-one's" (also known as "non-return-to-zero"). In each of those methods, the presence of a binary "1" is indicated by a spot of magnetic "saturation" (RZ, RB) or by the fact that magnetic saturation is changing from one polarity to the other in either direction (NRZ).

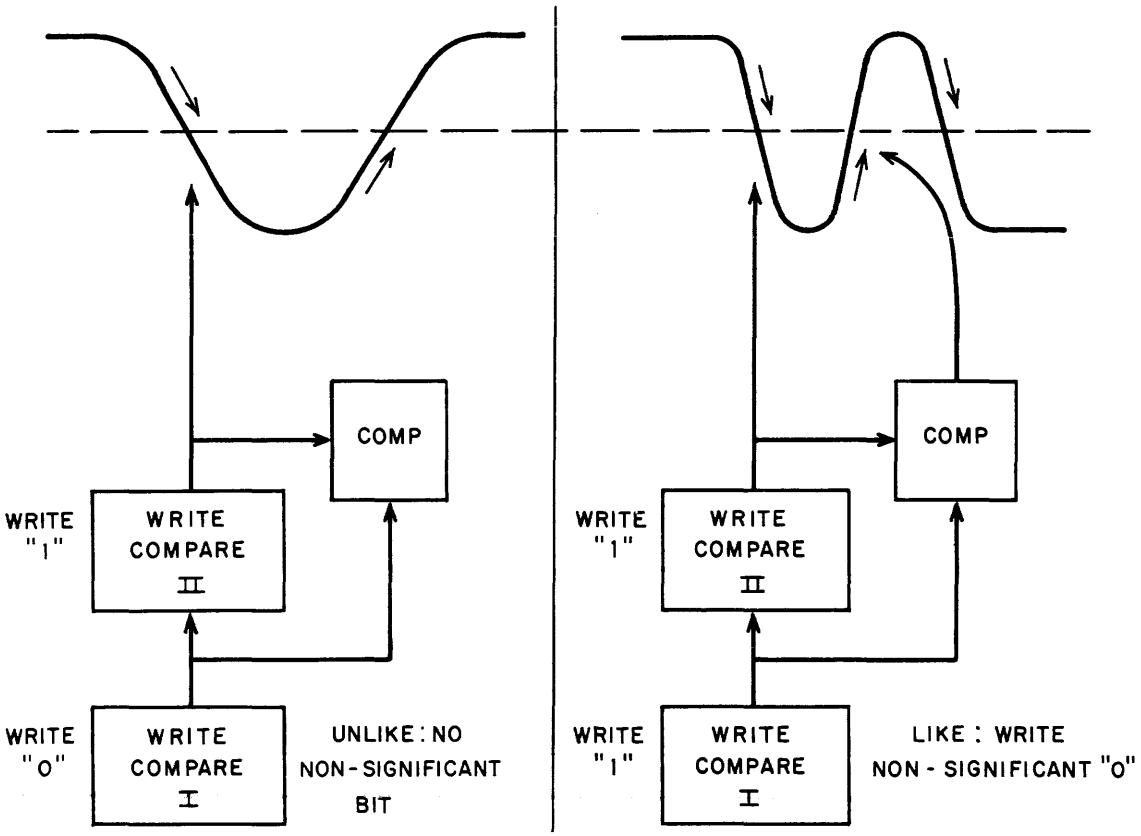
The pulse phase method makes use of the change from one polarity to another, but in this case the direction of the change is significant. For instance, a change from negative to positive would indicate a "0".



This method is based on the idea that the polarity must be changing in the right direction. If "1"s and "0"s are alternating in the data pattern, the natural flow assures that the polarity change is always correct. But, if the data pattern calls for "1"s or "0"s in adjacent positions, a non-significant bit is written on tape between those two significant bits to orient the polarity for proper definition of the significant bits. Reading circuitry recognizes only the significant bits, written at the 10 microsecond intervals.



When writing data, the circuitry for each channel must base its action not only on the bit currently being written on tape, but the next bit to be written; if the next bit is of the opposite value, no special action is taken, but if the next bit is of the same value, a non-significant bit of opposite value must be written between them. This is the reason for write compare circuitry, mentioned on page 14; the two registers record and compare the current and next bit for each tape channel.

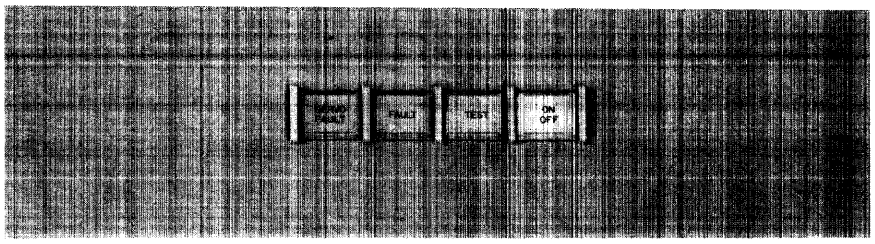


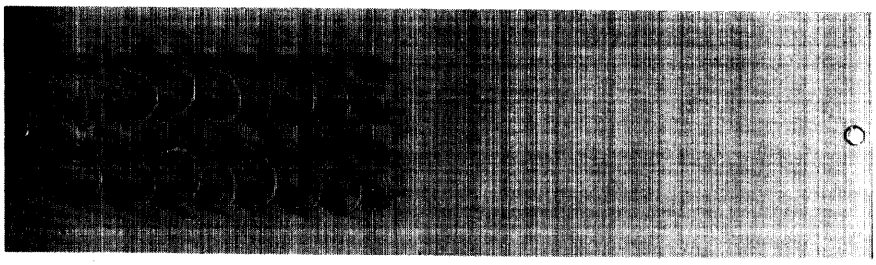
Additionally, the pulse phase method can permit blank tape to be "written". If not commanded to write, the writing circuitry will not cause a change of magnetic polarity; this will be read as nothing—neither "1" or "0". Many previous methods have required the tape's polarity to be either in a "1" or "0" state; there was no provision for blank tape.

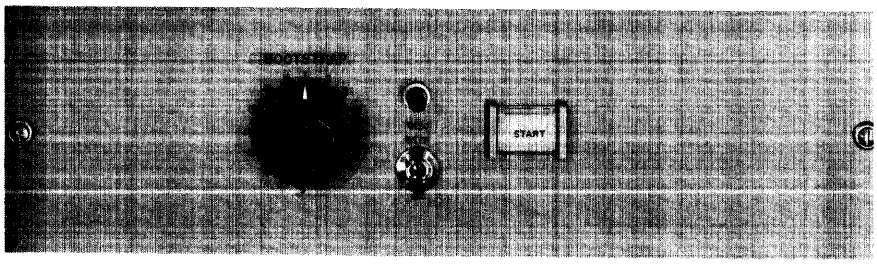
Test Mode When necessary for maintenance or other purposes, the subsystem can be disengaged from the Computer. This is accomplished by positioning a switch in the control cabinet. When the subsystem is in the test mode, the TEST indicator on the IIIA Control cabinet is lighted.

Controls Normal operations of the subsystem are monitored by indicators at the top front of the IIIA Control cabinet and of each UNISERVO tape unit. Certain abnormal conditions are also indicated on these panels; detailed maintenance analysis, however, is done at the maintenance panel at the back of the control cabinet.

For some tape unit functions, the indicator also includes a pushbutton for manual activation, independent of Computer program control. The indicators on the control cabinet are pictured and described below:







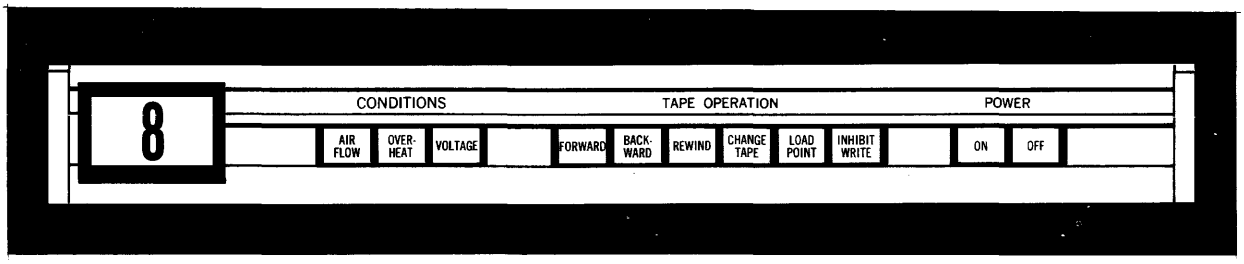
SERVO FAULT: voltage supply fault in any of the tape units.

FAULT: control cabinet fault: over-current, under-voltage, over-temperature, insufficient air flow, or mechanical interlock failure.

TEST: subsystem isolated from the computer by the TEST switch on the maintenance panel.

ON/OFF: alternate-action switch to control power to the control cabinet (except blowers and FAULT indicators).

The indicators on each UNISERVO unit are pictured and described below:



(NUMBER): white to illuminate logical number assignment of the specific tape unit (red if unit is not ready for use).

AIR FLOW: insufficient air flow in the tape unit cabinet.

OVER HEAT: cabinet temperature exceeds 130° F.

VOLTAGE: tape unit voltage fails.

FORWARD: tape transport is moving tape in the forward direction or is ready to do so; pressing the pushbutton conditions the transport for forward motion.

BACKWARD: tape transport is moving tape in the backward direction or is ready to do so; pressing the pushbutton conditions the transport for backward motion.

REWIND: tape transport is rewinding; pressing the pushbutton starts the rewind if the transport is conditioned for backward movement.

CHANGE TAPE: *Rewind With Interlock* instruction has been received.

LOAD POINT: tape has been mounted and has advanced to the Load Point, or a tape has rewound to the Load Point.

INHIBIT WRITE: the tape is rewinding or a reel without a Write Enable ring has been mounted.

ON: power is applied to all tape unit circuitry; pressing the pushbutton applies power.

OFF: power is removed from tape unit circuitry; pressing the pushbutton removes the power.

APPENDIX A. UNISERVO IIIA SUBSYSTEM INSTRUCTION REPERTOIRE

CODE*		NAME	DESCRIPTION
01	11	WRITE	Write one block of data
02	12	CONTINGENCY WRITE	Write "0"s in even channels for 2.5 inches,
03	13	WRITE FILE SEPARATOR	Erase 2.5 inches of tape.
41	51	READ FORWARD	Read one block of data, forward.
61	71	READ BACKWARD	Read one block of data, backward.
42	52	REPOSITION READ FORWARD	Skip the block of data at the read head and read the next block.
62	72	REPOSITION READ BACKWARD	Read one block of data, backward.
45	55	SEARCH FORWARD	Read (forward) first word of each block, comparing to Identifier Word. When match occurs, read specified number of words. Stop when end of block is detected.
65	75	SEARCH BACKWARD	Read (backward) last word of each block, comparing to Identifier Word. When match occurs, read specified number of words. Stop when end of block is detected.
46	56	MASKED SEARCH FORWARD	Read (forward) first word of each block, comparing to portions of Identifier Word validated by Mask Word. When match occurs, read specified number of words. Stop when end of block is detected.
66	76	MASKED SEARCH BACKWARD	Read (backward) last word of each block, comparing to portions of Identifier Word validated by Mask Word. When match occurs, read specified number of words. Stop when end of block is detected.
20	30	REWIND	Rewind tape, stopping at the Load Point.
21	31	REWIND WITH INTERLOCK	Set interlock requiring manual intervention, and rewind tape, stopping at Unload Point.
40	50	BOOTSTRAP	Terminate current operation, rewind the tape on the tape unit selected for bootstrap operation on the IIIA Control panel, and read forward one block of data.
23	33	TERMINATE	Terminate the current operation.

*1st column, without interrupt; 2nd column, with interrupt

APPENDIX B. BASIC PROGRAMMING EXAMPLES

The UNISERVO units are controlled by programmed instructions from the Computer through the Channel Synchronizer and tape control circuitry. These instructions order the UNISERVO units to read data (backward or forward) into the Computer, to write data (forward only) from the Computer, to search for specifically-identified data (forward or backward), and to perform other housekeeping functions. Reading and writing begin at the point on the tape immediately positioned under the read/write head; searching causes tape movement until the data is found (or end-of-file is detected), after which the specified number of words in the "find" block is read.

READ

Reading from the tape requires two Instruction Words with their Associated Access-Control Words, and one Function Word. All words are in core storage. In this example, up to 6531_8 words are read from logical unit 3 on channel 2, and sent to location 000471 (and the adjacent higher-numbered locations) in the Computer:

ADDRESS	PROGRAM INSTRUCTION WORD	ADDRESS	ACCESS-CONTROL WORD	ADDRESS	FUNCTION WORD
000401	f j a b h i u 75 00 02 00 0 0 001442 f and j: input mode. a: channel 2. b, h, and i: unused in this example. u: address of Access-Control Word.	001442	006531 000471 Rightmost 6 octal digits specify starting storage location. Next 5 octal digits plus 1 binary digit specify number of words. Leftmost 2 binary digits specify that incrementation should take place (destination address increases by 1 for each word received). NOTE: 00 - Increment 10 - Decrement 01 or 11 - Neither		NONE
000402	75 10 02 00 0 0 001443 f and j: function mode. a: channel 2. b, h, and i: unused in this example u: address of Access-Control Word.	001443	000001 001444 Rightmost 6 octal digits specify location of Function Word. Next 5 octal digits plus 1 binary digit specify number of words to complete instruction sequence. Leftmost 2 binary digits for incrementation (not applicable).	001444	710000 000003 Rightmost 4 binary digits specify logical number of tape unit selected. Leftmost 2 octal digits specify function (Read backward with interrupt). Other digits unused.

WRITE

Writing on tape requires three Instruction Words, two Access-Control Words, and one Function Word. The function mode instruction must precede the output mode instruction. In this example, 5000 $_8$ words are taken from location 000600 (and up) to be written on logical unit 2, channel 3.

ADDRESS	PROGRAM INSTRUCTION WORD	ADDRESS	ACCESS-CONTROL WORD	ADDRESS	FUNCTION WORD
010311	f j a b h i u 75 10 03 00 0 0 021500 f and j: function mode. a: channel 3. b, h, and i: unused in this example. u: address of Access-Control Word.	021500	000001 021501 Rightmost 6 octal digits specify address of Function Word. Next 5 octal digits plus 1 binary digit specify the number of Function Words. Leftmost 2 binary digits for incrementation (not applicable).	021501	110000 000002 Rightmost 4 binary digits specify logical number of tape unit selected. Leftmost 2 octal digits specify function (write). Other digits unused.
010312	75 12 03 00 0 0 010312 f and j: function mode jump. a: channel 3. b, h, and i: unused in this example. u: address of this instruction, to repeat it until channel 3 is no longer in the function mode.		NONE		NONE
010313	75 04 03 00 0 0 021502 f and j: output mode. a: channel 3. b, h, and i: unused in this example. u: address of Access-Control Word.	021502	005000 000600 Rightmost 6 octal digits specify starting source location. Next 5 octal digits plus 1 binary digit specify number of words to be transferred. Leftmost 2 binary digits for incrementation (not applicable).		NONE

SEARCH

Search requires four Instruction Words, three Access-Control Words, one Function Word, and one Identifier Word. Either forward or backward search may be programmed, but each requires a separate instruction sequence. Forward search compares the first word of each block to the Identifier Word; when identity is noted, the specified number of words is read into the Computer. Backward search compares the first word of each block as read backward to the Identifier Word; when identity is noted, the specified number of words is read into the Computer. The Identifier Word may be any configuration of 36 bits. In either direction, search is terminated if the End-Of-File Sentinel is detected. In this example, backward search is directed to logical unit 4 on channel 4 with Identifier Word 123456765432 and a maximum read-in of 300 $_8$ words to location 000320 (and the next higher adjacent addresses).

ADDRESS	PROGRAM INSTRUCTION WORD	ADDRESS	ACCESS-CONTROL WORD	ADDRESS	FUNCTION/IDENTIFIER WORD
	f j a b h i u				
000402	75 00 04 00 0 0 000447				
	f and j: input mode.	000447	000300 000320		NONE
	a: channel 4.		Rightmost 6 octal digits specify starting destination location.		
	b, h, and i: unused in this example.		Next 5 octal digits plus 1 binary digit specify maximum number of words to be read.		
	u: address of Access-Control Word.		Leftmost 2 binary digits specify that incrementation is to take place.		
000403	75 10 04 00 0 0 000450				
	f and j: function mode.	000450	000001 000451		
	a: channel 4.		Rightmost 6 octal digits specify location of first Function Word.	000451	750000 000004 (Function)
	b, h, and i: unused in this example.		Next 5 octal digits plus 1 binary digit specify number of words to complete instruction sequence.		Rightmost 4 binary digits specify logical number of tape unit selected.
	u: address of Access-Control Word.		Leftmost 2 binary digits for incrementation (not applicable).		Leftmost 2 octal digits specify function (search backward, with interrupt)
					Other digits unused.
000404	75 12 04 00 0 0 000404		NONE		NONE
	f and j: function mode jump.				
	a: channel 4.				
	b, h, and i: unused in this example.				
	u: address of this instruction, to repeat it until channel 4 is no longer in the function mode.				
000405	75 04 04 00 0 0 000452				
	f and j: output mode.	000452	000001 000453		
	a: channel 4.		Rightmost 6 octal digits specify location of Identifier Word.	000453	123456 765432 (Identifier)
	b, h, and i: unused in this example.		Next 5 octal digits plus 1 binary digit specify number of words to complete identity sequence.		Configuration of binary digits to which last word of each block is to be compared.
	u: address of Access-Control Word.		Leftmost 2 binary digits for incrementation (not applicable)		

APPENDIX C. PHYSICAL SPECIFICATIONS, UNISERVO IIIA SUBSYSTEM

	TAPE UNIT	POWER SUPPLY	IIIA CONTROL CABINET
HEIGHT (inches)	68¾*	96*	96*
WIDTH (inches)	31	66	20
DEPTH (inches)	30	32¾	34½
WEIGHT (pounds)	750	2800	625
FLOOR LOADING (lbs./sq. ft)	116	186.5	130.5
HEAT DISSIPATION (BTU/hour)	7500	10,200#	3000
AIR FLOW (CFM) (internal blowers)	350	2,300	350
TEMPERATURE RANGE	60 to 80° F		
HUMIDITY RANGE	40% to 70%		
POWER REQUIREMENTS	Supplied By Power Supply	208 VAC 60 CPS, 3 phase 3.8 KVA	208 VAC, 3 phase 400 CPS regulated, 600 W; 60 CPS unregulated, 200W

*Including cable tray above cabinet
#Full load, 16 tape units

CABLING RESTRICTIONS

Computer to Control cabinet:	300 feet maximum
Control cabinet to tape unit:	50 feet maximum
Power Supply to tape unit:	50 feet maximum

APPENDIX D. OPTIONS

The UNISERVO IIIA Magnetic Tape Subsystem as thus far described is the "normal" subsystem, but various options are available in configuration, and one option for tape format may be had.

Configuration The usual IIIA Control cabinet is Type 8003-08, wired for single-channel connection to one computer system. However, three other configurations are possible:

Single-Computer, Dual-Control. A modified (Type 8003-13) channel synchronizer/control cabinet is connected to a second input/output channel of the same Computer, controlling the same tape units as the first control cabinet. This second control cabinet cannot accept a *Write* command, however; so the system writes into one tape unit using the normal control cabinet and simultaneously reads from another tape unit using the modified second control cabinet; or both controls can perform read functions for separate tape units simultaneously.

Dual-Computer, Single-Control. Two separate computer systems may have access to the same channel synchronizer/control cabinet (Type 8003-09) and the tape units controlled by it.

Dual-Computer, Dual-Control. Two computer systems, through either of two control cabinets (Types 8003-10 and 8003-12) can communicate with the same group of tape units. As above, one control cabinet can handle a *Read* command only, so a computer system needing to write must communicate with the other control cabinet.

In each dual configuration, control switching circuitry exists to assure orderly assumption and release of control.

Tape Format If desired, the normal 5-frame 8-bit tape format may be changed, by means of a patchboard within the control cabinet, to a 6-frame 6-bit format. The relationship between a register containing a word and the disposition of bits onto the tape in the 6-frame format is illustrated below:

TRACK	TAPE MOVEMENT					
1	0	6	12	18	24	30
2	2	8	14	20	26	32
3	4	10	16	22	28	34
4	X	X	X	X	X	X
5	P	P	P	P	P	P
6	X	X	X	X	X	X
7	1	7	13	19	25	31
8	3	9	15	21	27	33
9	5	11	17	23	29	35

DIGITS REPRESENT BIT POSITIONS
P = PARITY BIT
X = ZERO FILL

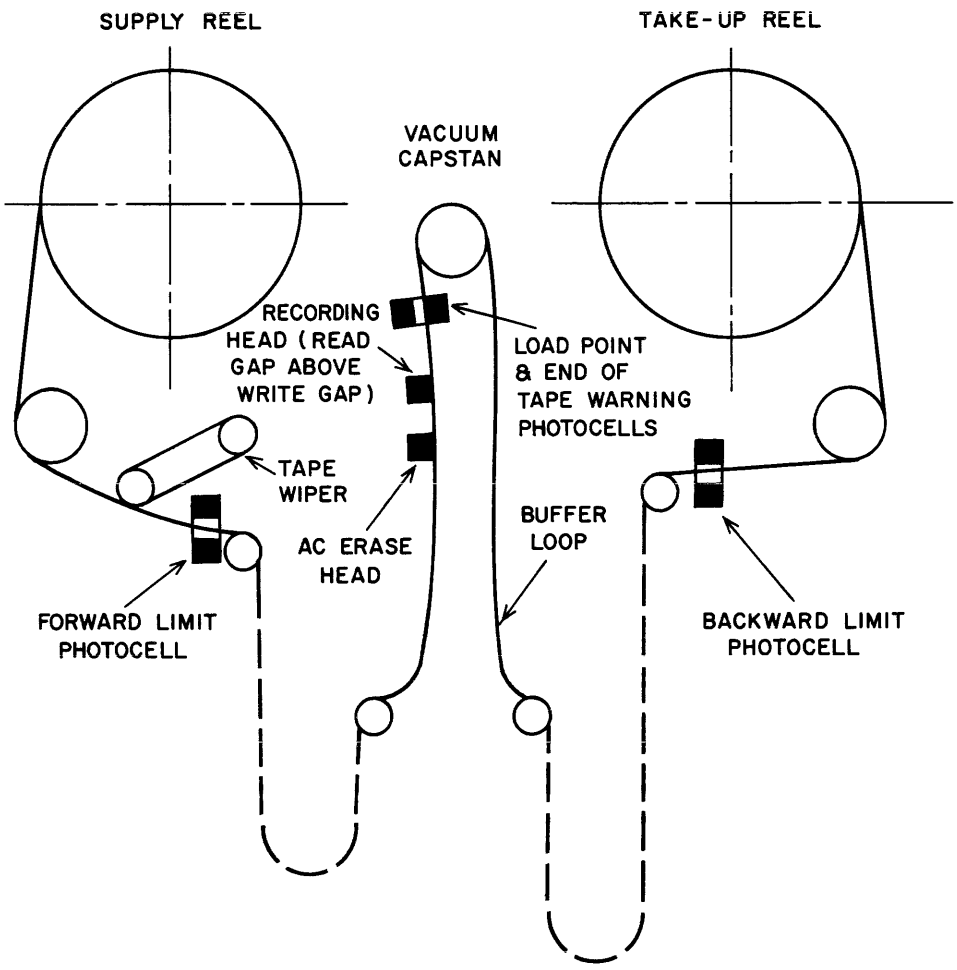
This change can be made at time of manufacture. It can also be made in the field when the system philosophy changes. The hardware is not designed to provide for frequent changes from the 8-bit format to the 6-bit format and back to the 8-bit format.

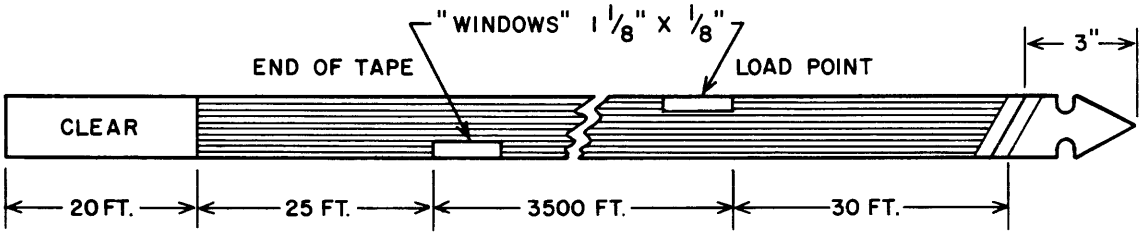
Programming As a result of the options for configuration, three additional function codes and one status code are necessary. They are used only during dual operations. The function codes are these:

CODE*		NAME	DESCRIPTION
24	34	CLEAR, LOCAL	Computer with control of subsystem relinquishes control
25	35	CLEAR, REMOTE	Non-controlling computer demands control
26	36	REQUEST AVAILABILITY	Non-controlling computer requests control

*1st column, without Interrupt; 2nd column, with Interrupt

The additional status code is coded 14_8, and is returned to the Computer when a UNISERVO unit requested is under control of the other control unit in a dual-configured subsystem.


SUPPLY REEL
TAKE-UP REEL
VACUUM CAPSTAN
RECORDING HEAD (READ GAP ABOVE WRITE GAP)
LOAD POINT & END OF TAPE WARNING PHOTOCELLS
TAPE WIPER
AC ERASE HEAD
BUFFER LOOP
FORWARD LIMIT PHOTOCELL
BACKWARD LIMIT PHOTOCELL


"WINDOWS" 1 1/8" X 1/8"
3"
END OF TAPE
LOAD POINT
CLEAR
20 FT.
25 FT.
3500 FT.
30 FT.

UNIVAC

DIVISION OF SPERRY RAND CORPORATION

PRINTED IN U.S.A. UP-3407 Rev. 1