ELLIOTT 900

Volume 1: FUNCTIONAL SPECIFICATION

Part 4: PERIPHERAL EQUIPMENT

Section 1: 9 Kc/s MAGNETIC TAPE SYSTEM (DPA 341/2/3/4), SPECIFICATION NUMBER 1020

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Section 1.4.1 - 9K c/s MAGNETIC TAPE EQUIPMENT

INFORMATION BULLETIN NUMBER 1

This Section should be altered in accordance with the information contained in this Bulletin. The Bulletin should then be inserted after page ii in Section 1.4.1.

Page	Reference	Information
2 (Issue 2)	2.2	Amend Width from 60 inches to 58 inches Amend Depth from 31 inches to 35 inches

Chapter 1: INTRODUCTION

The 903 9 Kc/s Magnetic Tape System consists of a controller and up to four tape handlers. Instructions may be issued via the controller to any handler.

The system is designed to operate upon $\frac{1}{2}$ inch wide tape, using 7 tracks, and at a speed of 45 inches per second for reading and writing. The packing density is 200 characters per inch, giving a data transfer rate of 9 Kc/s.

A tape handler consists of a mechanism to control the tape movement, an operator control panel, a read/write head stack, an erase head, beginning and end of tape photosense heads, and individual pre-amplifiers for the data read off each track. A shared electronics unit contains main amplifiers, threshold level and peak detector circuits for each track, and write head drivers for each track.

The controller is designed to operate from a 903 standard peripheral interface. Data is transferred across the interface as 18-bit words which are then re-assembled into 6-bit characters before being transferred to the shared electronics unit. Data may be checked within the controller using either odd of even parity, and logic is included to test for long or short record errors. No logic is provided for detecting noise blocks.

Records may only be written or read while the tape is moving in the forward direction. However the presence of data may be detected while the tape is moving in the reverse direction so that it is possible to retreat over a record. The system is designed to use a self-clocking technique, and thus it is impermissible to write a character consisting of seven zeros.

Only one Read, Write, Erase or Backspace may occur in the system at a time. A Rewind instruction however is off-line to the controller so that any number of handlers may rewind simultaneously. It follows that a read, write, erase or backspace instruction may also take place while any number of the remaining handlers are rewinding.

The tape stops at the completion of each instruction. No continuous running facilities are provided in either the forward or reverse directions. No remote power on/off switching facilities are included. Each handler is allocated a fixed predetermined number.

The system is designed to conform to the ECMA-5 standard.

There are two modes of operation - interrupts may be used or inhibited as required. Furthermore the block transfer facilities of the 903 may, or may not, be used for reading and writing onto the tape.

Chapter 2: SYSTEM LAYOUT

2.1 The system consists of a 4 handler suite in a single console cabinet and a separate controller.

2.2 The console cabinet contains 4 tape handlers and the shared electronics unit. (The cabinet may also be supplied with only 1, 2 or 3 handlers fitted and filler panels, as required.)

The outline dimensions of the console cabinet are:-

Height - 63 inches

Width - 60 inches

Depth - 31 inches

The weight of a cabinet containing 4 tape handlers is 1,250 lbs.

2.3 The controller is housed in a 903 standard desk. The interface between the controller and shared electronics unit is completely digital, and the controller may be placed up to 25 feet away from the console cabinet.

2.4 The power for the console cabinet is completely self-contained. The power is supplied via one input cable from a mains socket.

2.5 The controller will also require its own mains supply via one input cable from a mains socket.

Chapter 3: DATA STRUCTURE

3.1 Data to be written is transmitted from the 903 to the controller as an 18-bit word. The word is then split into three 6-bit characters such that bits 18 to 13 inclusive form the first character written on the tape, bits 12 to 7 inclusive form the second character, and bits 6 to 1 inclusive form the third character.

For each character a seventh parity bit is generated. The parity may be odd or even dependent on the mode currently selected. Thus each 18-bit word is written onto the tape as three consecutive 7-bit characters.

Similarly 7-bit characters are read from the tape and the parity bit is checked. A block must be read in the same parity mode as it was written. The parity bit is then discarded, and the six data bits re-assembled into an 18-bit word, the first character read being packed at the most significant end of the word.

Thus it follows that a 9 kilo-character per second data rate off the tape requires a data transfer rate of only 3 kilo-words per second across the 903 peripheral interface, i.e. a word every 333 μsecs., nominally.

Chapter 4: OPERATIONS

The following operations are possible, and must only be used in the sequences described below. Any departure may result in complete system hold-up, or in Do Nothing sequences (see Section 7.10).

1. Writing data on the selected handler
2. Reading data from the selected handler
3. Issuing a Control Word to select a handler and/or move tape, etc.
4. Reading the Status Word to determine the state of the system
5. Writing a tape mark.

4.1 WRITING

4.1.1 Method 1

15 5121 - Prepare to write (Control Word)

15 5120 - Write-a-word

15 5122 - Close Block

To write data on the selected handler, the above sequence of instructions is sent from the computer. If the write permit ring is fitted in the file reel on the handler, and if the selected handler is not in Manual, the instructions are accepted. Otherwise they are regarded as Do Nothing instructions. The write-a-word instruction is a class 15 instruction which transfers one 18-bit word from the accumulator to the tape.

A Prepare-to-write instruction (see section 4.3) is issued to start the tape moving. When the tape has reached its nominal recording speed (or after 9 msecs. minimum in the case of a Do Nothing), an interrupt is generated. The interrupt must be answered within 250 μsecs by issuing the first Write-a-word instruction. The first word of data is then written onto the tape, and a further interrupt is generated 250 μsecs before the second word of data is required. Similarly the second and all subsequent interrupts must be answered within 250 μsecs., and in this way data is supplied by the computer to satisfy the data transfer rate onto the tape. After the last word has been transmitted to the tape system, a further interrupt is generated. This interrupt must also be answered within 250 μsecs by issuing a Close Block instruction which will indicate to the tape system that no further data is to be written. If a Do Nothing sequence is in progress, a final interrupt is now given provided that tape motion has ceased; otherwise the interrupt is given at the end of the tape stop sequence. A Status Word instruction

(see section 4.4) may now be issued in response to this final interrupt, but there is no restriction on the processor's response time to this interrupt.

If a Status Word instruction is issued at any time during a Write operation other than in response to the final interrupt, then receipt of the Status Word instruction will terminate the block being written, in the same way as a Close Block instruction, but the Status Word and Reply will not be made available until the tape stop sequence is complete. Thus, in the case of a genuine Write operation the computer will be held for at least 20 msecs; however after a Do Nothing operation, the Status Word will be made available at once.

If any interrupt other than the final interrupt is not answered within the 250 μsecs allowed, the Missed Data Transfer Bit (bit 3) in the Status Word will be set to 1 and the block being written will be terminated forthwith. However, interrupts will still be generated at the normal rate in response to subsequent instructions until the Close Block instruction is issued. The data transmitted by the processor will be ignored.

If any instruction other than a Write-a-word, Close Block, or Status Word instruction is issued while the write operation is in progress, then the instruction will be held up indefinitely and the SELECTED lamp on the controller will be lit (but see also section 4.1.3).

4.1.2 Method 2

15 5121 - Prepare-to-write (Control Word)

14 5120 - Write-a-block

15 5122 - Close Block

This method uses the block transfer facilities of the computer. The Write-a-block instruction is a class 14 instruction which transfers a block of words from the core store to the tape system.

In this case, a Prepare-to-write instruction is issued to start the tape moving as before. When the tape system is ready to accept the first word of data, an interrupt is generated which must be answered within 250 μsecs by issuing the Write-a-block instruction. The block length is determined by the computer, i.e. writing continues until the Block Transfer signal from the computer goes false. An interrupt is then generated which must be answered within 250 μsecs by issuing a Close Block instruction. The tape then enters the stop sequence, and a final interrupt is generated when the tape has come to a standstill. A Status Word instruction may now be issued in response to the interrupt. If a Status Word instruction is issued at any other time during the Write operation, it will terminate the block being written, but the Status Word will not be made available until the tape comes to rest.

The operation of the Do Nothing and Missed Data Transfer bits of the Status Word is as defined in section 4.1.1.

Any instruction, other than a Write-a-block, Close Block, or Status Word instruction, will be held up indefinitely, and the SELECT lamp on the controller will be lit (but see also section 4.1.3).

4.1.3 The two alternative methods of writing can be used together if required, i.e. a Write-a-word instruction may be followed by either further Write-a-word instructions or by a Write-a-block instruction. Similarly, a Write-a-block instruction may be followed by one or more Write-a-word instructions before issuing a Close Block instruction. However the timing requirements specified herein will still apply.

4.1.4 At the end of a block a check character is written after a gap of approximately four characters. The check character, which is known as the Longitudinal Check Character, makes the total number of "ones" written in each track an even number, irrespective of the parity mode of the controller.

During writing the read head re-accesses the data from the tape and checks it for correct parity, both transverse and longitudinal. In the event of a check failure, the parity bit is set in the Status Word (bit 4).

Current will flow in the write and erase heads for as long as the tape is in motion in order to erase the interblock gaps.

4.2 Reading

4.2.1 Method 1

15 5121 - Prepare-to-read (Control Word)

15 1024 - Read-a-word

15 5122 - Close Block

To read data from the selected handler, the above sequence of instructions is sent from the computer. If the selected handler is set to Remote, the instructions are accepted and obeyed. Otherwise they result in a Do Nothing sequence. The Read-a-word instruction is a class 15 instruction which inputs an 18-bit word to the accumulator.

A Prepare-to-read instruction (see section 4.3) is issued to start the tape moving. When the tape reaches its nominal recording speed and the first word is being read from the tape (or after 14 msecs minimum if the instructions are being treated as Do Nothings), an interrupt is generated. This must be answered within 250 μsecs by issuing the first Read-a-word

instruction. Similarly while the second word is being read from the tape, a second interrupt is generated, and so on, so that the computer accepts data at a rate which satisfies the data transfer rate of the tape mechanism. A further interrupt is generated after the transmission of the last data word, and this must be answered by the issuing of a Close Block instruction. The tape now goes into a stop sequence, and a final interrupt is generated when the tape has come to rest (or immediately, in the case of a Do Nothing sequence provided that tape motion has ceased). This final interrupt may be answered by the issuing of a Status Word Instruction.

The amount of data read off the tape is determined solely by the length of the block on the tape. Thus if the block on the tape contains more words than that expected by the computer, then the remaining words will be read after the Close Block instruction has been received, but the corresponding interrupts will not be generated, and the data will not be transferred to the computer. The Long Record bit (bit 6) in the Status Word will be set to "1".

If the block on the tape contains less words than that expected by the computer, then after the last word has been read dummy words containing 18 zero bits and interrupts will be generated at the normal rate until a Close Block instruction is received. The Short Record bit (bit 5) in the Status Word will be set to "1".

If a Status Word instruction is issued at any time during a Read operation other than in response to the final interrupt generated after the Close Block instruction has been issued, then the Status Word instruction will itself terminate the data transfer to the computer but the Status Word will not be made available until the tape comes to rest. Thus the computer will be held up for at least 11.8 msecs and the Long Record bit (bit 6) in the Status Word will be set to "1".

If any interrupt other than the final interrupt is not answered within 250 μsecs the Missed Data Transfer bit (bit 3) in the Status Word will be set to "1", and the subsequent data transferred to the computer will be undefined. However, interrupts will still be generated at the normal rate in response to subsequent instructions until a Close Block instruction is received.

If any instruction other than a Read-a-word, Close Block, or Status Word instruction is issued while the read operation is in progress, then the instruction will be held up indefinitely, and the SELECTED lamp on the controller will be lit (but see also section 4.2.3).

4.2.2 Method 2

15 5121 - Prepare-to-read (Control Word)

14 3072 - Read-a-block

15 5122 - Close Block

This method uses the block transfer facilities of the computer. The Read-a-block instruction is a class 14 instruction which transfers a block of words from the tape system to the core store.

In this case, a Prepare-to-read instruction is issued to start the tape moving, as with Method 1. While the first word is being read, an interrupt is generated, which must be answered within 250 μsecs by issuing a Read-a-block instruction. Data will be read off the tape until the end of block is detected, but the length of the block transferred is determined by the computer, i.e. data will continue to be transferred until the Block Transfer signal from the computer goes false. The controller then generates an interrupt which must be answered within 250 μsecs by issuing a Close Block instruction. When the end of the block is detected, the tape enters its stop sequence, and a final interrupt is generated when the tape has come to rest. A Status Word instruction may now be issued in response to this interrupt. If a Status Word instruction is issued at any other time during a Read operation, it will be held up until the tape comes to rest.

If the end of the block is detected before the computer sends the Close Block instruction, then less words have been read off the tape than the computer expected. The controller immediately initiates the stop-tape sequence and the short record bit (bit 5) in the Status Word will be set to "1". However, dummy words containing 18 zero bits and interrupts will continue to be sent to the computer until the Close Block instruction is received.

If the end of the block is detected after the computer has sent the Close Block instruction, then more words have been read off the tape than the computer expected. The controller continues to run the tape forwards until the entire block has been read but no data will be transferred to the computer and no corresponding interrupts will be generated, after the Close Block instruction has been received. The Long Record bit (bit 6) in the Status Word will be set to "1".

The operation of the Do Nothing and Missed Data Transfer bits of the Status Word is as defined in section 4.2.1.

Any instruction, other than a Status Word instruction, used while the read operation is in progress, will be held up indefinitely and the SELECTED lamp on the controller will be lit (but see also section 4.2.3).

4.2.3 The two alternative methods of reading can be used together if required, i.e. a Read-a-word instruction may be followed by either further Read-a-word instructions or by a Read-a-block instruction. Similarly a Read-a-block instruction may be followed by one or more Read-a-word instructions before issuing a Close Block instruction. However the timing requirements specified herein will still apply.

4.2.4 Data is read off the tape as a series of seven bit characters. The data is checked for both transverse and longitudinal parity, and the parity bit (bit 4) in the Status Word is set in the event of a failure. Data will continue to be read until the end of the block is detected (see section 7.5).

Data is only read from the tape when the tape is running at its nominal recording speed.

If an attempt is made to read data from a blank tape, the resulting tape motion is undefined.

4.3 CONTROL WORD

15 5121 Output control word from the accumulator to the controller.
Only bits 1 to 10 of the control word have significance as follows:-

BITS	EFFECT
1, 2	2-bit binary address specifying the handler. These bits are decoded and the connection is established before the other bits are interpreted. Thus the remaining control word bits apply only to the selected handler.
3, 4	Not used.
5	When set to 1, interrupts are permitted. When set to 0, interrupts are inhibited.
6	When set to 1, select odd parity

BITS	EFFECT
7	When set to 1, select even parity If bit 6 = bit 7 = 0, parity mode remains in previous state. If bit 6 = bit 7 = 1, result is undefined.
8,9,10	These bits are decoded as follows:-

Bit 10	Bit 9	Bit 8	
0	0	0	No tape motion.
0	0	1	Erase
0	1	0	Backspace
0	1	1	Rewind
1	0	0	Prepare to write a tape mark
1	0	1	Prepare to read
1	1	0	Prepare to write
1	1	1	Rewind in manual

These instructions are defined in the following sections:-

4.3.1 ERASE

To erase approximately 4 inches of tape on the selected handler an Erase instruction is issued, and will be accepted provided that the controller and handler are both not busy. If the handler is not set to Remote, or if the file reel is not fitted with a Write Permit ring, the instruction is regarded as a Do Nothing.

If the handler is set to Remote and a Write Permit ring is fitted, the tape moves forward, and approximately 4 inches of tape are erased before it again comes to rest. The controller will be busy from the time the Erase instruction is received until the tape comes to rest at the end of the instruction, at which time an interrupt will be generated. If a Status Word instruction is issued prior to the interrupt occurring, the computer will be held up until the controller becomes not busy.

4.3.2 BACKSPACE

To retreat over one block on the selected handler, a Backspace instruction is used. The tape is moved in the reverse direction until one block has been traversed. The tape is then stopped with the read/write heads suitably placed in the previous interblock gap to enable the block just traversed to be re-read or over-written. (See also section 7.6 for over-writing procedures.)

If the Beginning of tape marker is encountered during a Backspace operation, the tape is immediately stopped and bit 11 is set in the Status Word. If a Backspace instruction is issued when the tape is at the Load Point, it will be treated as a Do Nothing instruction, and bit 11 will be set in the Status Word.

The controller will be busy from the time the Backspace instruction is received until the tape again comes to rest at the completion of the instruction, at which time an interrupt is generated. If a Status Word instruction is issued prior to the occurrence of the interrupt, the computer will be held up until the controller becomes not busy.

4.3.3 Rewind and Rewind in Manual

To rewind the tape on the selected handler, either a Rewind or a Rewind-in-Manual instruction is used. These two instructions are identical except that a Rewind- in-Manual instruction puts the handler into the manual state as soon as the rewind has been initiated.

Both instructions move the tape at high speed in the reverse direction until the Load Point is detected. The tape then slows down, stops, and automatically moves forward again to relocate at the Load Point.

If a Rewind-in-Manual instruction is issued when the tape is at the Load Point it will be treated as a Do Nothing instruction, and will not put the handler into the Manual state.

The handler will be busy from the time the Rewind instruction or the Rewind-in-Manual instruction is received until the tape has relocated at the Load Point, and able to obey a further forward moving instruction, i.e. bit 1 of the Status Word will be set to 1. No interrupt is generated at the completion of a Rewind or a Rewind-in-Manual instruction.

A Status Word instruction may be issued and answered at any time while a Rewind operation is in progress.

4.3.4 Prepare-to-Write

A Prepare-to-write instruction is used to start the tape moving forwards. The instruction is impermissible in isolation and must be followed by a Write-a-word or a Write-a-block instruction in response to the interrupt generated when the tape is running at its nominal recording speed.

A Prepare-to-write instruction invariably makes the controller busy, and the controller will remain busy until the following write operation is completed. If a Prepare-to-write instruction is followed by any instruction other than those specified above, the computer will be held up

indefinitely, and the SELECTED lamp will be illuminated. The resulting effect is undefined.

4.3.5 Prepare-to-read

A Prepare-to-read instruction is used to start the tape moving forwards. The instruction is impermissible in isolation and must be followed by a Read-a-word or Read-a-block instruction in response to the interrupt generated when the tape is running at its nominal recording speed.

A Prepare-to-read instruction invariably makes the controller busy, and the controller will remain busy until the following read operation is completed. If a Prepare-to-read instruction is followed by any instruction other than those specified above, the computer will be held up indefinitely, and the SELECTED lamp will be illuminated. The resulting effect is undefined.

4.3.6 Prepare-to-write-a-tapemark

A Prepare-to-write-a-tapemark instruction is used to start the tape moving forwards. The instruction is impermissible in isolation and must be followed by a Write-a-word instruction in response to the interrupt generated when the tape is running at its nominal recording speed.

A Prepare-to-write-a-tapemark instruction invariably makes the controller busy, and the controller will remain busy until the following write operation is completed. If a Prepare-to-write-a-tapemark instruction is followed by any instruction other than that specified above, it must be assumed that the computer will be held up indefinitely, with the SELECTED lamp illuminated. The result of any such sequence is undefined.

4.4 Status Word

15 1025 Input Status Word of the currently selected handler to the accumulator. Each handler has a Status Word. The bits have the following significance:-

BITS	SET BY	CLEARED BY
1. Handler Busy	Accepting a Rewind instruction, or a Rewind-in-Manual instruction.	Completing a Rewind instruction or a Rewind-in-Manual instruction.
2. Handler in Manual	Handler in Manual state, or unavailable.	Handler in Remote state.

BITS	SET BY	CLEARED BY
3. Missed Data Transfer	Any interrupt, other than a final interrupt not being answered within 250 μsecs or a Write-a-word instruction not being followed by a further Write-a-word, Write-a-block or Close Block instruction within 250 μsecs. Similarly for Read-a-word instruction.	Accepting a Control Word instruction.
4. Parity Error	Parity check failure during a write or read operation.	Accepting a Control Word instruction.
5. Short Record	Reading a short block.	Accepting a Control Word instruction.
6. Long Record	Reading a long block.	Accepting a Control Word instruction.
7. Write Permit	File reel having a write permit ring fitted.	File reel not having a write permit ring fitted.
8. Load Point	Detecting the beginning-of-tape marker.	Not detecting the beginning-of-tape marker.
9. E. O. T.	The end-of-tape marker being detected while moving forwards.	Accepting a Control Word instruction.
10. Zero character	Detecting a false end-of-block	Accepting a Control Word instruction.
11. Done Nothing	An instruction having been treated as a Do Nothing	Accepting a Control Word instruction.

If bit 2 is set to "1", bits 1, 7, 8 and 9 of the status word have no significance.

Bits 12 to 18 inclusive are undefined and should be ignored.

All the Status Word bits are reset by a Control Word that selects a different handler, or by pressing the 'Reset' switch on the controller.

4.5 Writing-a-tapemark

15 5121 - Prepare-to-write-a-tapemark (Control Word)

15 5120 - Write-a-word

15 5122 - Close Block

To write a tapemark on the selected handler, the above sequence of instructions is sent from the computer. If the write permit ring is fitted in the file reel on the handler, and if the selected handler is not in manual, the instructions are accepted. Otherwise they are regarded as Do Nothing instructions. The Write-a-word instruction is a class 15 instruction which in this sequence transfers bits 6 to 1 of the accumulator to the tape. Bits 18 to 7 are ignored.

The Prepare-to-write-a-tapemark instruction (see 4.3) is issued to start the tape moving. When the tape has reached its nominal recording speed (or after 9 ms minimum in the case of a Do Nothing), an interrupt is generated. The interrupt must be answered within 250 μsecs by issuing the write-a-word instruction. The tapemark character (as represented by bits 6 to 1 of the accumulator word) is then written onto the tape, and a further interrupt is generated. This interrupt must also be answered within 250 μsecs by issuing the Close Block instruction. If a Do Nothing sequence is in progress, a final interrupt is given, provided that tape motion has ceased; otherwise the interrupt is sent at the end of the tape stop sequence. A Status Word instruction (see Section 4.4) may now be issued in response to this final interrupt, but there is no restriction on the processor's response time to this interrupt.

If a Status Word instruction is issued at any time during a Tapemark operation other than in response to the final interrupt, then receipt of the Status Word instruction will terminate the writing process, in the same way as a Close Block instruction, but the Status Word and Reply will not be made available until the tape stop sequence is complete. Thus, the computer will be held for at least 20 msecs.

If any interrupt other than the final interrupt is not answered within the 250 μsecs allowed, the Missed Data Transfer bit (bit 3) of the Status Word will be set to 1, and the writing process will be terminated forthwith. Interrupts will, however, still be transmitted at the normal rate until the Close Block instruction is issued. The data transmitted by the processor will be ignored.

If any instruction other than those specified in this section is issued while the tapemark operation is in progress, then the instruction will be held up indefinitely and the SELECTED lamp on the controller will be lit.

Chapter 5: CONTROLS

5.1 Controller Operator Control Panel

The desk housing the controller includes a control panel consisting of the following:-

5.1.1 POWER ON and POWER OFF Switches

These are momentary switches. The POWER OFF switch is illuminated red if mains power is available but the controller is not switched on. Pressing the POWER ON switch when the OFF switch is illuminated red will cause the controller to switch on. The ON switch is illuminated green and the light in the OFF switch is extinguished.

Pressing the OFF switch when the ON switch is illuminated green will cause the controller to switch off. The OFF switch is illuminated red and the light in the ON switch is extinguished.

The switching ON and OFF of the controller is independent of both the 903 computer and the handler console cabinet.

5.1.2 SELECTED Indicator

When illuminated yellow, this indicates that the controller is being addressed by the computer. It will thus flash intermittently during normal operation, but will remain on continuously in the event of an instruction being received which cannot be obeyed (usually because of a faulty program).

5.1.3 Reset Switch

This is a momentary switch, which, when pressed, will reset the controller to a defined state. All Status bits are reset.

5.2 Handler Operator Control Panel

Each handler has its own operator control panel consisting of the following:-

5.2.1 Power Switch

This is an alternate action switch. Pressing the switch once will switch on the handler, and the switch is illuminated green. Pressing the switch a second time will switch off the handler, and the light is extinguished.

5.2.2 Remote Switch and Indicator

This is a momentary switch. Pressing the switch when the Local indicator is illuminated red will cause the handler to enter the Remote state and be under program control. The Remote indicator is illuminated green, and the light in the Local indicator is extinguished.

5.2.3 Local Switch and Indicator

This is a momentary switch. Pressing the switch when the Remote indicator is illuminated will cause the handler to enter the Manual state. The light in the Remote indicator is extinguished and the Local indicator is illuminated red.

When power is first switched on, the handler is automatically set to the Manual state. If the handler is not available (e.g. due to a tape drive or servo fault), the handler will be in the Manual state but the light in the Local indicator is extinguished.

5.2.4 Reset Switch

This is a momentary switch which unconditionally stops the tape in both Manual and Remote states. The handler is also set to the Manual state if it was in Remote.

5.2.5 Forward Switch

This is a momentary switch which operates only in the Manual state. Pressing the switch will make the tape move forwards. The tape may be stopped by either detecting the Load Point or the end-of-tape marker, or by pressing the Reset switch.

5.2.6 Reverse Switch

This is a momentary switch which operates only in the Manual state. Pressing the switch will make the tape move in the reverse direction. The tape may be stopped by detecting the Load Point or the end-of-tape marker, or by pressing the Reset switch.

5.2.7 Rewind Switch

This is a momentary switch which operates only in the Manual state. Pressing the switch will make the tape move in the reverse direction at rewind speed. The tape is normally stopped by detecting the Load Point. In case of an emergency the tape may be stopped by pressing the Reset switch, but this is not recommended practice.

5.2.8 File Protect Indicator

When illuminated yellow, this indicates that writing cannot occur on the tape handler. The indicator is on if no file reel is mounted, or if a file reel is mounted which does not have a write permit ring fitted.

5.2.9 Select Indicator

When illuminated white, this indicates that the handler has been selected. A handler may only be selected if it is in the Remote state. Only one handler may be selected at a time.

Chapter 6: USE OF INTERFACE CONTROL LINES

6.1 RESET

This line, which is made true during the computer switch-on sequence, and also after the computer reset button is pressed, has the same effect on the controller as does the controller Reset switch.

6.2 INTERRUPT

6.2.1 There are two modes of operation, namely:-

(i) Operation with the interrupts permitted

(ii) Operation with the interrupts inhibited

The inhibiting of the interrupts merely prevents the interrupts from being transmitted to the computer and in no way affects the operation of the logic within the controller.

The recommended mode of use is with interrupts permitted as this allows the most efficient use of the computer time. If, however, interrupts are not used, it is the program's responsibility to ensure that instructions are issued at an appropriate rate to satisfy the data transfer requirements onto and off the tape. Such instructions will be held up until required by the tape.

If interrupts are inhibited, the Missed Data Transfer bit (bit 3) in the Status Word is set to "1" if a Write-a-word instruction is not followed by a further Write-a-word, Write-a-block, or a Close Block instruction within 250 μsecs. Similarly for Read-a-word instructions.

The first Write-a-word instruction must be made available within 9 msecs of issuing the Prepare instruction and the first Read-a-word within 14 msecs. Unless the first word is available for writing within 250 μsecs of it being required, then the Missed Data Transfer bit is set. Similarly for a reading operation.

If any of the timing requirements are not satisfied by the program, the resulting effect is undefined.

6.2.2 The final interrupt generated at the completion of a read or write operation, or the interrupt generated at the completion of an erase or backspace instruction need not be answered within a time limit. Normally, however, a Status Word instruction is issued but since the system is then idle, (i.e. the controller is not busy), any instruction may in fact be issued.

If interrupts are inhibited, then it is not essential to take any action when the operation is completed.

6.2.3 The standard system will operate on Interrupt Level 2.

Chapter 7: MISCELLANEOUS

7.1 Instruction Sequences

A Write-a-word instruction is impermissible unless preceded by a previous Write-a-word instruction, a Write-a-block instruction, or a Prepare-to-write instruction, or a Prepare-to-write-a-tapemark instruction.

Similarly, a Read-a-word instruction is impermissible unless preceded by a previous Read-a-word instruction, a Read-a-block instruction, or a Prepare-to-read instruction.

A Close Block instruction is only permissible after a Write-a-block, Read-a-block, Write-a-word or Read-a-word instruction.

7.2 CONTROLLER BUSY/HANDLER BUSY

A handler becomes busy in response to a Rewind or Rewind-in-manual instruction. Any instruction issued to a busy handler (with the exception of Status Word instructions, and Control Word instructions to Select the handler only) will be held up until the handler becomes unbusy.

The controller is busy whenever the tape is in motion performing any read, write, erase or backspace operation.

7.3 Load Point

At a position 4.6 ± 0.3 metres from the physical beginning of the tape, a reflective marker is placed. The marker, known as the beginning-of-tape reflective marker, defines the Load Point. When a tape is moved in the reverse direction, it is unconditionally stopped when the marker is detected by the photosense head. If a rewind is in progress, the tape will overshoot the marker before it comes to rest, but logic is included to automatically move the tape forwards again to relocate on the marker.

When the marker is beneath the photosense detector, bit 8 of the Status Word is set to "1". It is not possible for the computer to move the tape in the reverse direction when bit 8 is set, i.e. when the tape is at the Load Point.

There will be a minimum gap of 3 inches from the lagging end of the beginning-of-tape reflective marker to the first character of the first block written on the tape. Thus it is possible to backspace over the first block without detecting the marker.

7.4 End-of-Tape

Situated at the end of the tape as it feeds through the read/write heads is a reflective marker which indicates that the physical end of tape is near. Beyond this end-of-tape marker there are 7.6 (+1.5, -0) metres of usable tape. The presence of the marker in no way affects the reading or writing of data.

When the marker is passed while the tape is moving forwards, bit 9 of the Status Word is set to "1". The program must ensure that no more than 7.6 metres of tape are used after bit 9 has been set, otherwise the physical end of tape may be completely unwound from the file reel.

7.5 End-of-Block Detection

During reading or writing, a gap of $1\frac{1}{2}$ characters or more is taken to indicate that the block has terminated, and the tape is stopped. If, however, a character occurs during the first millisecond after the detection of the longitudinal parity check character, then bit 10 (zero character) is set in the Status Word indicating that the end-of-block-detected was not necessarily genuine.

A zero character is defined as one consisting of seven zeros. Such a character can only be deliberately written in the even parity mode, in which case it is the responsibility of the program to ensure that no zero character is so written. (Note that during the write operation a zero character will only be detected when the data is checked by the read circuitry about 8 msecs later.)

However an apparent zero character may appear at any time if one or more bits in a character are dropped, or if there are imperfections in the tape. Whenever a zero character is detected, the tape is immediately stopped.

During backspacing, the tape will only stop after a gap of more than 8 characters. It is therefore possible to backspace correctly over blocks containing zero characters; a necessary feature for the correct operation of the software rescue routines recommended below.

7.6 Sequence of Writing and Reading

Data is normally written on the tape as a series of consecutive blocks with the start of the first block defined by the beginning-of-tape reflective marker (Load Point).

A new block may be written if:-

(i) It is the first block defined by the marker

(ii) The preceding block has just been written

(iii) The preceding block has just been read

(iv) A block to be replaced has just been backspaced over.

The block so written will be called the "latest" block on the tape, until another block is written.

If these rules are followed, a block will be readable if it is either:-

(i) The first block

(ii) Immediately follows a readable block, other than the latest block.

Selective overwriting of a block situated amongst preceding and succeeding blocks is only possible if adequate program precautions are observed.

7.7 Program

It is strongly recommended that discrete block addressing is used by all programs, together with 'find' routines to locate on a particular address.

It is also recommended that when a tape is being written, an erase instruction is issued prior to a rewind instruction. An erase instruction, however, is not necessary prior to a backspace instruction.

7.8 Loading

To load the tape, a file reel is mounted on a handler and the tape manually threaded onto the take-up spool. The tape is moved forwards by pressing the FORWARD switch on the operator control panel. The tape stops at the Load Point. The handler may now be put into the Remote state, thus putting the tape under program control.

7.9 Power Switching

Each handler is switched on and off individually by means of the POWER switch on its operator control panel. Switching on any one handler will also switch on the power required for the shared electronics unit.

The controller is switched on and off by means of the POWER ON and OFF buttons on the controller desk.

In the event of a mains power failure, no damage shall result to either the tape or system equipment.

It is not permissible to switch on or off any handler while another handler is obeying a read, write, erase, or backspace instruction.

The tape will not be marked in the event of a mains power failure unless a write or an erase operation is currently in progress.

7.10 "Do Nothing" instructions and Computer Hold-up

Do Nothing instructions are those which occur in a correct sequence, but for some reason cannot be obeyed. Thus, if a write or erase instruction is initiated when writing is not permitted on a handler, the sequence of instructions will be accepted, but treated as a series of Do Nothing instructions, i.e. Reply signals will be sent in response to Select, and interrupts will be generated normally, but the instruction is otherwise ignored. The interrupt following the Prepare-to-write instruction is delayed, as usual, by about 9 msecs, and subsequent interrupts follow at the normal rate, but the final interrupt (after Close Block) is not delayed, provided that the tape stop sequence is complete. In this way the computer is best enabled to carry on with its other work in a time-shared system.

Similarly, if instructions are sent to a handler which is in the Manual state, they are regarded as Do Nothing commands, and no tape motion results. If, however, the tape is already in motion, and the handler becomes set to Manual (e.g. due to a fault condition) while obeying a sequence of instructions, the tape will immediately enter the stop sequence and subsequent instructions will be treated as Do Nothing commands.

Whenever an instruction is treated as a Do Nothing, Status Word bit 11 is set.

If, however, a sequence of instructions is sent which could never be obeyed, e.g. a Prepare-to-read followed by a Write-a-word; then Computer Hold-up occurs; the machine is held up indefinitely and the SELECTED lamp is lit.

7.11 Non-integral number of words

If the number of characters read off the tape is not an integral number of words, the least significant end of the last word transmitted to the computer will be filled with zero characters. The short record bit in the Status Word will not be set.

Thus in the case of the single character tapemark block, only one significant word will be transmitted, containing the tapemark character in bits 18 to 13, and all zeros in bits 12 to 1. Note that the tapemark word as read is different from the word as written.

Chapter 8: INSTALLATION REQUIREMENTS

8.1 Power Supplies

The power supplies required for the system are as follows:-

230V ± 10%, 50 c.p.s. ± 2% a.c. single phase

The power consumption requirements are as follows:-

	Power Consumption (KVA)		
	Maximum	Operating Average	Average Heat Dissipation (Btu/h)
Console with 1 Transport	1.25	0.63	2,200
Console with 2 Transport	2.50	1.25	4,300
Console with 3 Transport	3.75	1.88	6,500
Console with 4 Transport	5.00	2.50	8,600
Controller (same in all cases)	0.50	0.25	860

8.2 Environmental Conditions

The environmental conditions for the system are as follows:-

Temperature +10°C to +30°C
Relative Humidity 20% to 95%, without condensation.

No specific dust control is required other than to ensure a typical office environment and maintain reasonable standards of cleanliness.

Although the system is designed to operate over the temperature and relative humidity ranges quoted above, it is desirable to keep the installation environment well within the limits stated to maintain maximum margins of operation. If the nominal environmental conditions of the installation are likely to approach the limits stated, the advice of the manufacturers should be sought.

The temperature and humidity ranges are independent of each other. Rapid changes in temperature, however, may appreciably change the relative humidity of the atmosphere, and thus the temperature may not be cycled from one extreme of the operating range to the other in less than two hours.

8.3 Weight

Controller: 150 lbs.
Console cabinet: 1250 lbs. (with 4 handlers)

8.4 The magnetic tape console should not be positioned within 10 feet of any paper tape, line printer, or card equipment. Any air flow through the installation should take paper dust from such equipment away from the magnetic tape console.

Appendix 1

Summary of Operating Characteristics

Recording format	200 RPI ECMA.5 compatible
Tape speed	45 inches per second
Tape length	2,400 feet ($10\frac{1}{2}$ in spool) 1,200 feet ($10\frac{1}{2}$ in spool)
Data transfer rate	9,000 characters per second (3,000 words per second)
Packing density	200 characters per inch
Interblock gap	0.75 inches
Rewind speed	180 inches per second (approx.)

Appendix 2

ENGINEERING FACILITIES

The logic of the controller is designed around a microprogram, so as to simplify commissioning and servicing; to enable the full benefit of this feature to be obtained, two engineer's switches are included, by means of which the logic may be stepped through the various function sequences under manual control.

App2.1 On line/test/pulse switch

When this switch is set to the "on-line" position, the system is ready to function normally, and will respond to signals sent by the central processor. When it is set to 'test', the engineering test mode is selected, and the switch may be further depressed to the 'pulse' position, so as to step through the logic in a manner determined by the second switch (see below).

App.2.2 Osc. stop/cycle step/cycle repeat switch

When this switch is set to the 'osc.stop' position, one clock pulse is generated each time the pulse switch is depressed (see above), the operation of the oscillator being inhibited; in the 'cycle stop' position, the oscillator runs normally, but each time the pulse key is pressed the logic runs through one cycle only; in the 'cycle repeat' position, the logic cycles continuously at one microprogram address, and steps on to the next address each time the 'pulse' key is depressed.