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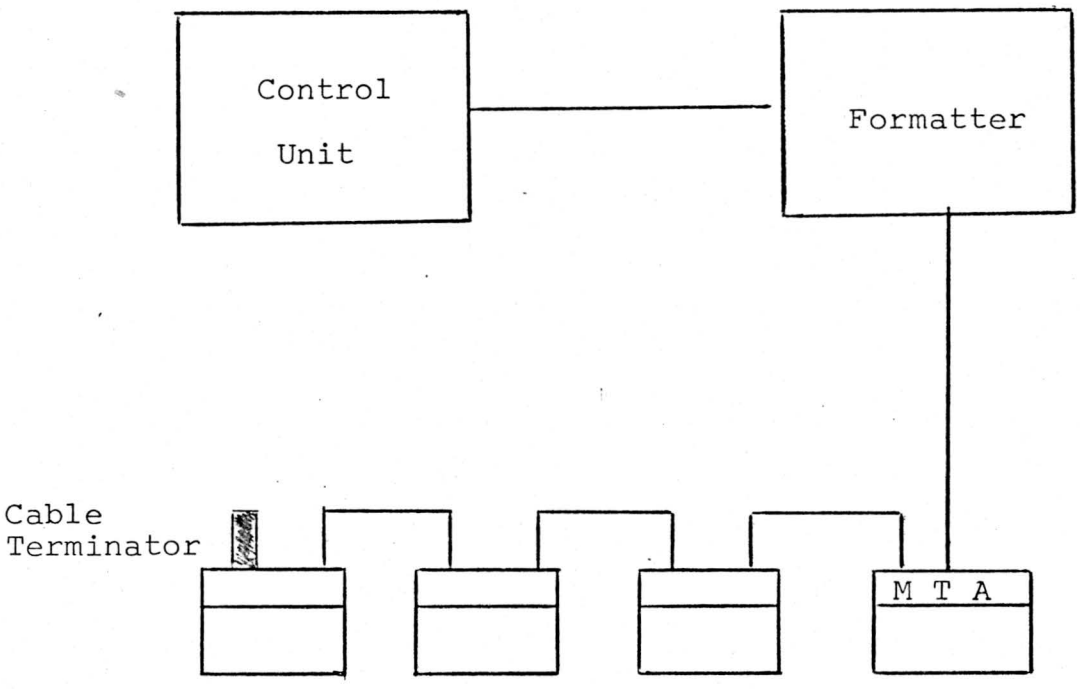
1 - SCOPE

The 9 track magnetic tape system used with Sagittaire computers, provides for writing and reading ANSI and IBM compatible NRZI formats.

The magnetic tape control unit is designed to control one PEC Formatter, Model F849/7. The formatter, on its turn, can control up to 4 tape transports, models 68 XO-9 or 78 XO-9.



Four transports

2 - APPLICABLE DOCUMENTS

PERTEC Engineering specification N° 100 911
6 X 40 Series tape transport.

PERTEC Engineering specification N° 101 611
7/9 Channel NR Z1 Formatter.

PERTEC Operating and service manual N° 101 600
NR Z1 formatter model F8X9/7

PERTEC Operating and service manual N° 100 884
Synchronous read after write tape transport model 6 X 40.

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5 - EXTERNAL LOGIC INTERFACE

1. Signals from CU to Formatter unit

20 lines are used.

TADO
TAD1 } Transport address lines

GO : Initiate command specifie by command lines REV/FWD, WRT/READ, WFM, EDIT, ERASE

REV : Forward or reverse tape motion

WRT : Read or write mode

WFM : Write File mark

EDIT : Edit condition

ERASE : Erase tape in write mode

REW : Rewind command

OFL : Off line command

LWD : Last word of the record in write mode

FEN : Formatter enable

WO to W7 : 8 write data lines.

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2. Signals from formatter to CU

21 lines are used.

FBY : Formatter busy

DBY : Data busy (in read or write mode).

CCG : Check character gate (transmission a CRC or a LRC character)

HER : Hard Error
A read error has been detected by the formatter.

FMK : File mark detected

RDY : Transport Ready

ONL : Transport on line

FPT : Transport is file protected

LDP : Transport at load point

EOT : Transport at End of tape

WSTR : Write data strobe

RSTR : Read data Strobe

RP, RO to R7 : 9 read data lines

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6 - FUNCTIONAL PERFORMANCE

6.1 Basic information

6.1.1. Tape unit characteristic

MODEL : PEC 6840-9

Type of encoding : NRZ1 IBM compatible

Tape speed : 37,5, 25, 18,75 or 12,5 ips

Data density : 9 track - 800 bpi

Start time : 12 ms $\pm$ 1.0 at 25 ips

Stop time : 3 ms $\pm$ 1.0 at 25 ips
(inversely proportional to tape speed).

Start/Stop displacement : 0,19 inch $\pm$ 0,02

Rewind speed : 150 ips nominal

Reel size : 10 ½ inch.

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6.1.2. Formatter specifications

Model	F 849/7
Recording Mode (IBM and ANSI compatible)	NRZ1
Packing density	200 - 800 bpi
Configuration	read after write
Type of vertical parity	ODD parity

The formateur is capable of execution the commands listed in the table. When a command is received from the controller the formatter goes "busy" and performs all control and timing functions necessary to execute the command. Any errors occuring during the commands are reported to the controller. The formatter indicates at the controller the completion of the command and the controller is then free to issue a further command.

Two other command lines are provided which cause the transport to rewind or to be switched off-line. These commands are routed directly to the selected transport and do not cause the formatter to go busy.

An automatic read-after-write data check is performed during each write command Read-after-write data is transmitted to the controller in the same manner as during read commands.

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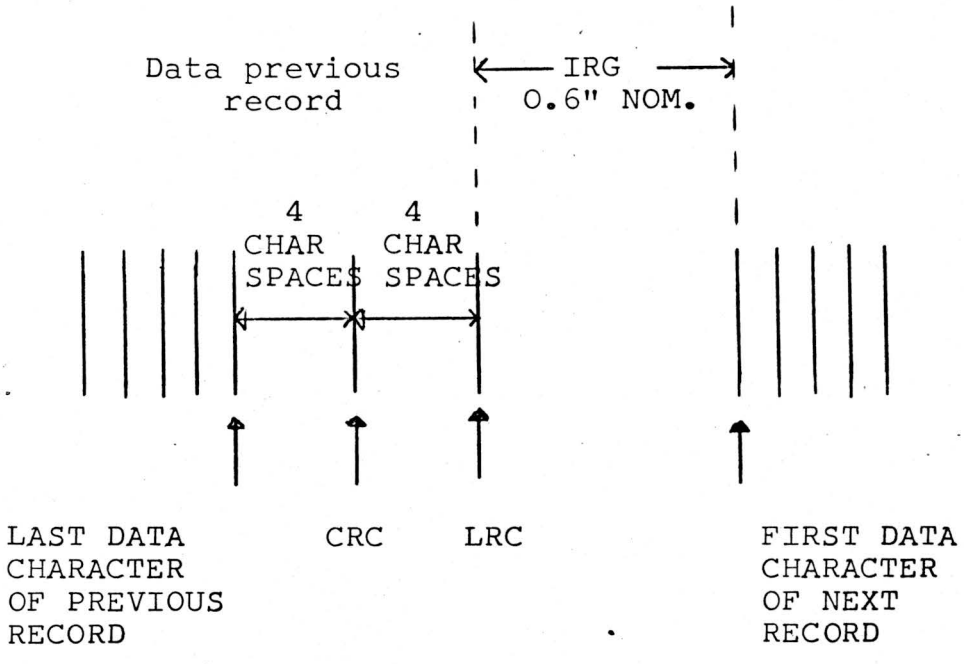
- command coding

Command	REV	WRT	WFM	EDIT	ERS
Read forward					
Read reverse (norm.)	X				
Read reverse (Edit.)	X			X	
Write (Norm.)		X			
Write (Edit.)		X		X	
Write file mark		X	X		
Erase (fixed length)		X	X		X

- Information on tape is arranged in record blocks.



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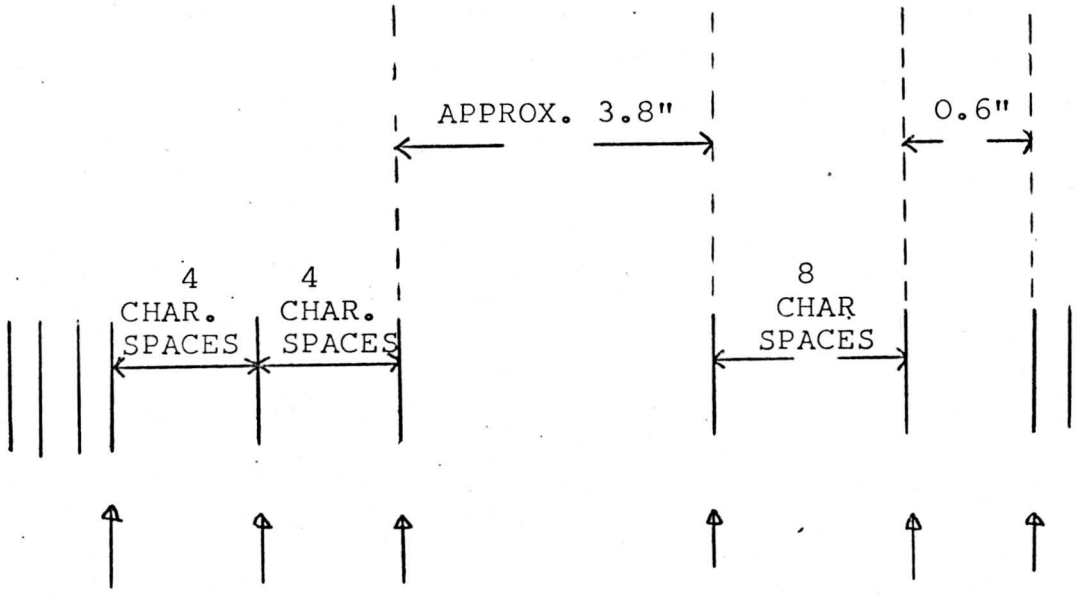
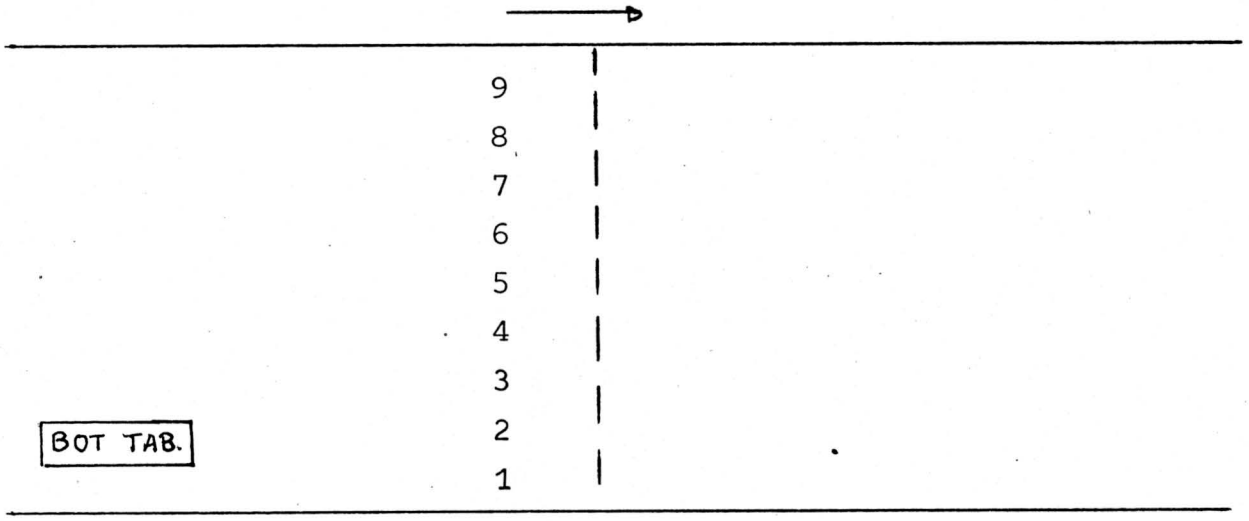


- Tracks arrangement (oxide aspect)

FORWARD MOTION (HEAD RELATIVE TO TAPE)



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- bits value

Track number	Binary value	EBCDIC Correspon-dance	ASCII 8 Correspon-dance	File mark code
4	P	P	8	0
7	2^7	0	0	0
6	2^6	1	1	0
5	2^5	2	2	0
3	2^4	3	3	1
9	2^3	4	4	0
1	2^2	5	5	0
8	2^1	6	6	1
2	2^0	7	7	1

6.1.3. Control unit characteristics

The tape control unit is connected to the central processor via the multiplex channel (or simplex channel).
It controls and executes all the commands available on the formatter unit.

The correspondance between the bin lines and the tape unit tracks is given by the following table :

4	7	6	5	3	9	1	8	2	Track number
7	8	9	10	11	12	13	14	15	Bin lines

In write mode, the parity bit is not transmitted from CPU. The exchange is executing in character mode

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mode for the multiplex channel.

In read mode, the parity bit is transmitted to CPU and the CRC and LRC character, for correcti on in data fault. The exchange is executed in word mode for the multiplex channel.

Device address

BAD 0	BAD 1	TAPE N°
0	0	0
0	1	1
1	0	2
1	1	3

6.2. Input/Output commands

6.2.0 Summary

The control unit has to recognize the following commands

- TST
- CIO Start
- CIO Stop
- OTR
- INR
- SST

During the execution of any I/O command a not recognized device address sets the condition register to "3".

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In a general way, a refused I/O command sets the condition register to "1" and an accepted one, resets is to "0".

Before any I/O operation, a TST may be used.

Any CIO command assigned to an "inoperable" tape unit is accepted if the control unit is in the "inactive" state but not performed. In this case, the control unit goes to the "status request" state. It energizes the interrupt line and waits for a SST command. The bit 15 of the status word is set.

Twelve CIO commands given on the following table can be executed. They are distinguished from the function field of the I/O commands.

Commands	Functions Field					
BOU LINES	10	11	12	13	14	15
- Off line	1	X	X	0	X	X
- Rewind	1	X	X	1	X	X
- Write	0	0	0	0	1	1
- Write edit	0	0	1	0	1	1
- Write File mark	0	1	0	0	0	1
- Erase gap	0	1	1	0	0	1
- Read	0	0	0	0	1	0
- Search File mark forward	0	1	0	0	0	0
- Search File mark backward	0	1	0	1	0	0
- Forward space block	0	0	0	0	0	0
- Backward space block	0	0	0	1	0	0
- Backward space block edit	0	0	1	1	0	0

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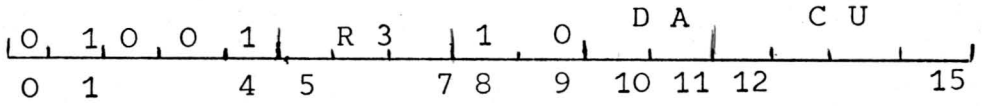
Bit signification :

15	Write (if 1) or Read (if 0)
14	Echange
13	Reverse (if 1) or Forward (if 0)
12	Edit or Erase
11	File mark
10	No ready after command.

6.2.1. TST Test status command



R3 : indicates the register into which status is loaded during this instruction.

DA : Tape unit address

CU : Control Unit address

- This instruction may be used, before starting any I/O operation, to test if the device control unit is in ready state. It is always accepted by the control unit.

- During the execution of TST, the BIN contents are sent into R 3 register. A one bit in position 15 indicates the control unit is busy (not ready) Others bits are not significant.

The TST command, when executed, does not disturb

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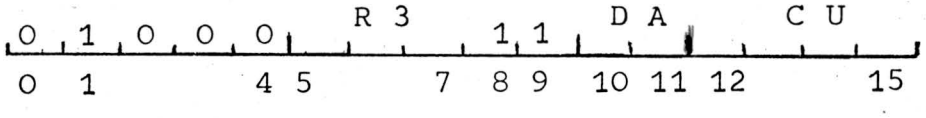
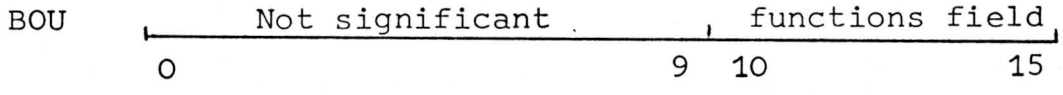
the eventual running operation of the control unit.

6.2.2 CIO Start commands



DA : Tape unit address
CU : Control unit address
R 3 : The contens present on the BOU lines indicates functions relative to the I/O operation to be started



- This command is accepted only if the control unit is in the "Inactive" state and if the tape is not moving.

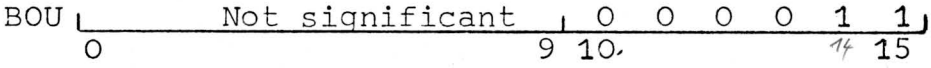
In a normal way, if the command is accepted, the following operations occur :

- The condition register is reset to "0".
- The control unit switches to "Execute state".
- The control unit selects the tape unit concerned through the formatter and sends

to the formatter the command specified in the BOU lines.

- At the end of the operation, the control unit goes to the "status request" state ; it energizes the interrupt line and waits for an SST command, excepted for an OFF line and a rewind command.

6.2.2.1 Write



- This command is used to write on the tape a block of data fetched from main storage.

- The selected tape unit moves tape forward and writes characters taken on the BOU lines.

- A write command assigned to a file protected tape unit is accepted by the C. U but not executed. In this case the C. U goes to the "Status request" state, activates the interrupt line waiting for a SST command.

The bit 6 of the status word is set.

- If a throughput error occurs during a write command, the data transport is interrupted, the formatter terminates the block in a normal way by the CRC and the LRC.
The bit 14 of the status word will be set.

- If parity errors are detected during a write

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operation, after the whole block has been written, the C. U goes to the "status request" state. The bit 13 of the status word will be set.

If a write operation is performed in the EOT area the bit 4 is set in status word.

Execution time

- for a normal data block

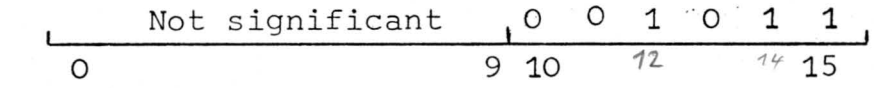
  at 25 ips : 17,1 ms + n x 50 us + 6,6 ms

- for the first data block placed at the beginning of the tape

  at 37,5 ips : 151 ms + n x 33 µs + 4,4 ms
  at 25 ips : 227,5 ms + n x 50 µs + 6,6 ms

n : number of characters contained in a block.

6.2.2.2 Write edit.



This command is identical with write command, but it is required when it is desired to change a particular record in the midst of many records.

When performing an Edit function, the selected record must first be read in the reverse direction, in edit mode. The new block should be the same length as the block it is replacing.

A write edit command, not ~~before~~ preceded by a backward

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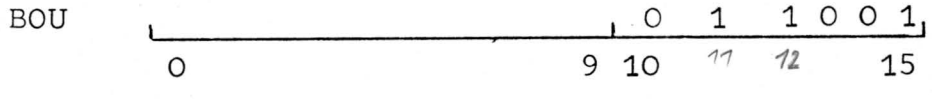
space block edit is accepted but not performed by the control unit. The C. U. goes to the "status request" state, energizes the interrupt line and wait for a SST command.
The ~~both~~ backward space bloc and write edit command must ~~be~~ follow. one another
The bit 11 of the status word is set.

6.2.2.3 Erase gap



This command is used to erase tape for a distance of approximately 3,8 inches.

The selected tape unit moves tape forward, erases a part of the tape and stops.

As for a write command, the C. U. accepts an Erase gap command assigned to a file protected tape unit but not executed. In this case the C. U. goes to the "Status request" state, activates the interrupt line to ask for a SST command. The bit 6 of the status word will be set.

If an erase operation performed in the end of tape area, the bit 4 of the status word will be set.

Execution time :

139,03 ms a 25 ips
94,13 ms a 37,5 ips

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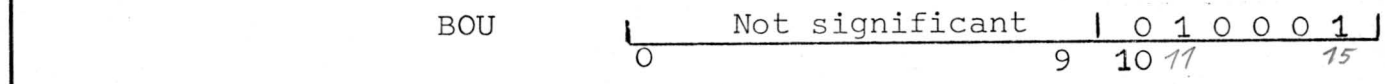
6.2.2.4 Write file mark



This command is used to write a tape mark (a one-byte block followed by the LRC) on tape. There is no data exchange with Channel. Only this command should be used to write a F. M.

- The selected unit moves tape forward, writes the tape mark block and realizes before the tape stops, an interblock gap.

A write tape mark command assigned to a file protected tape unit is accepted but not performed by the Control Unit. The C. U goes to the "Status request" state, energizes the interrupt line and wait for a S. S. T. command. The bit 6 of the status word will be set.

When a write tape mark is performed, the parity is controlled. If an error is detected, it is indicated in the status word (bit 13).

If a write tape mark is performed in the end of the tape area the bit 4 of the status word is set.

Execution time :

145,68 ms	a	25 ips
100,78 ms	a	37,5 ips

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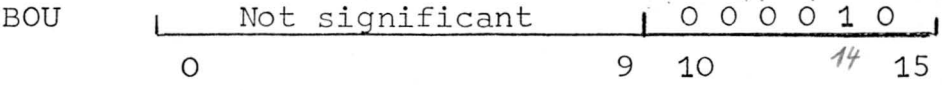
6.2.2.5. Read forward



This command is used to read forward a block of data

- The selected tape unit moves tape forward and sends the characters read on the tape to the BIN lines.

- When the interblock gap is reached the tape stops.

If the operation is terminated by a channel end or a stop command while the block is not finished, the read operation is completed like a space block (without data transport).
The bit 12 of the status will be set. It will be set too if the block is finished while the C. U. has received neither the channel end signal, nor a stop command.

If a throughput error occurs during a read command, the data exchange is interrupted ; the C. U. terminates the operation like a space block.
The bit 14 of the status word will be set.

The formatter controls the parity while reading by the vertical and longitudinal parity checks.

If parity errors are detected, the C. U., after the block has been completly read, activates the interrupt line to ask for a S. S. T. command.

The bit 13 of the status word will be set. Some reads will be tried by successive backspace and read commands.

Reading a File mark block when a read command is performed sets the bit 3 of the status word.
The tape stops immediatly after the detected mark.
The F. M. configuration found anywhere within a block are not followed by any indication in the status word.

Execution time

30,2 ms	+	n	x	50 µs	a	25 ips
20,1 ms	+	n	x	33,3µs	a	37,5 ips

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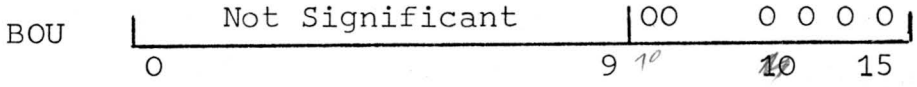
6.2.2.6. Forward Space Block



This command is used to move tape forward to the next interblock gap.

- the selected tape unit moves tape forward. There is no data exchange and no parity control.

- when the next interblock gap is reached the tape stops.

If a File mark is detected during a space block, the bit 3 of the status word is set.

Execution time

at 25 ips	30,2 ms + n x 50 µs
at 37,5 ips	20,1 ms + n x 33,3 µs

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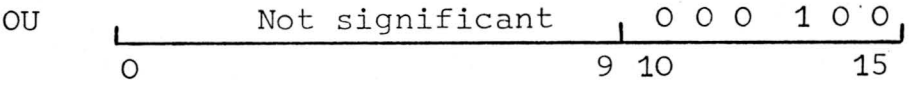
6.2.2.7 Backward Space block



This command is used to move tape backward to the ~~next~~ previous interblock gap or to load point.

- The selected tape unit moves tape backward
- When the ~~next~~ previous interblock gap is on the load point -which ever comes the first- is reached, the tape stops.

The detection of load point after a backspace block is indicated in the bit 5 of the status word.

A backward space block command assigned to a tape unit placed at load point is accepted and not performed. The C. U. goes to the "Status Request" state, energizes the interrupt line and waits for a S. S. T. command. The bit 5 of the status word is set. If a File mark is detected during a space block, the bit 3 of the status is set.

Execution time

a 25 ips	32,9 ms + n x 50 µs
a 37,5 ips	20,1 ms + n x 33,3 µs

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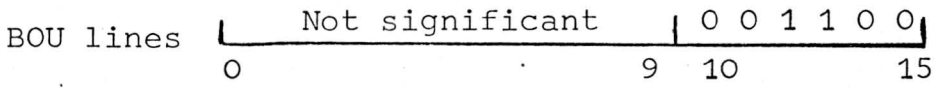
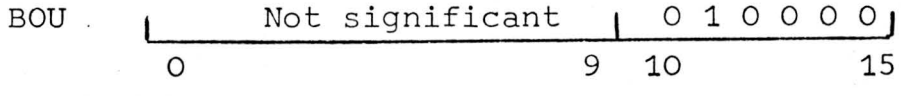
6.2.2.8. Backward space block edit



For the C. U. this command is identical as the backward space block and this is used before a write edit command.

6.2.2.9. Search File mark forward



This command is used to move tape forward to the interblock gap beyond the next tape mark.

- The selected tape unit moves tape forward.

- When the interblock gap following the next tape mark is reached the tape stops.

- If the end of tape marker is detected, the block of datas writed on the marker is read, then the controller stops the tape and goes to the "Status Request" state, energizes the interrupt line and waits for a SST.
The bit 4 of the status word is set.

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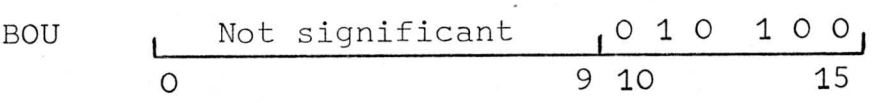
6.2.2.10 Search File mark backward



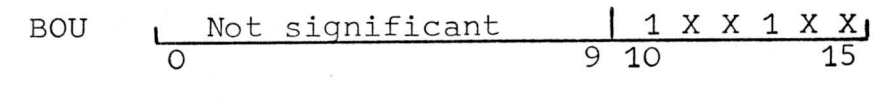
This command is used to move tape backward to the interblock gap beyond the next tape mark or to load point.

- The selected tape unit moves tape backward

- When the interblock gap following the next tape mark or the load point -whichever comes first- is reached the tape stops.

A search tape mark backward command assigned to a tape unit placed at load point is accepted and not performed. The C. U. goes to the "Status request" state, energizes the interrupt line and waits for a S. S. T. command. The bit 5 of the status word will be set.

6.2.2.11 Rewind



This command is used to rewind tape to load point.

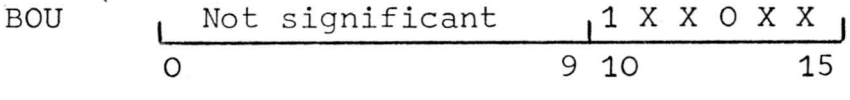
- The selected tape unit moves tape backward and when the load point is reached the tape stops.

After the control unit has initiated the tape

movement, it becomes able to accept commands for other tape units. (A command for the tape performing the rewind, would be followed by a status interrupt and the bit 2 of the status word would be set).

When the tape unit becomes ready after the rewind operation, the C. U. asks for a S. S. T. command ; the bit 1 of the status word will be set.

6.2.2.12 Off-line



This command causes the selected tape unit to revert to the off-line mode. As soon as this command is accepted by the tape unit, it becomes "inoperable".

A command for this tape unit is not followed by a status interrupt.

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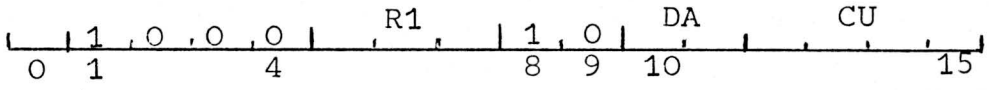
6.2.3. CIO Stop



R1 : Not significant
DA : Tape unit address
C. U. : Control Unit address

A stop command is always accepted and the condition register is always set to zero. It is used in abnormal conditions.

Two cases may be occurred :

- If the formatter is not initialized, the C. U. goes to wait status state and the tape does not move.
- If the formatter has been initialized, the C. U stops the tape in the interbloc gap found after the CIO stop.
  The CIO Start accepted during a write or write edit command, stops the data transfer and the formatter writes on the tape, the CRC and LRC characters.

  The Rewind and Off line commands are not disturbed by a stop command.

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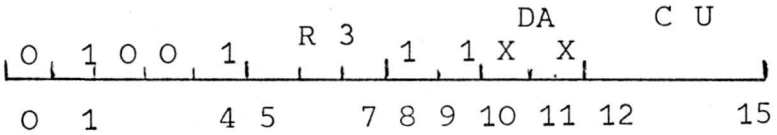
6.2.4 SST Command



X : Don't care

R 3 : Register into which the status word is sent.

C. U : Control unit address

This command is used to get a status word from the Control Unit.

If the command is accepted the condition register is set to "0", and a status word is sent into the accumulator, via the BIN lines and the interrupt line is reset.

A Send Status command is accepted if the Control Unit is in "Status request" state.

If the command is refused the condition register is set to 1 and the contents of the accumulator will not be significant.

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6.3. Status configuration

During an accepted SST the BIN lines have the following meaning :

- 15 Devices not operables (formatter or tape unit)
- 14 Throughput error
- 13 Data fault
- 12 Incorrect length
- 11 Program error
- 10 Tape number 0
- 9 1
- 8 2
- 7 3
- 6 Write not enable
- 5 Load point
- 4 End of tape
- 3 FM detected
- 2 Rewinding
- 1 Was not ready

6.3.1. Not operable

Bit 15 is set if the tape unit is not ready to receive a command except when the tape unit is engaged in a rewind operation in on line condition (in this case the bit 2 is set).

- Inter locks are not made
- Initial load is not complete
- the transport is not on line
- the formatter is power-off

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6.3.2. Throughput error

This bit (14) is set during a read or write command of the multiplex channel does not answer an exchange request, coming from the C. U., in the allowed time.

The data exchange is stopped.

6.3.3. Data fault

This bit (13) is set during a read or write command or search command if a read error has been detected by the formatter for one or more of the following reasons :

- Vertical parity error on data character
- Longitudinal parity error
- CRC parity error
  (detected during any execution of a read forward command only).

6.3.4. Incorrect length

This bit (12) is set during a read command whenever the tape block length is different from the channel block length.

6.3.5. Program Error

This bit (11) is set wherever the control unit receives

- from the Multiplex channel an invalid code
  command Read and OTA from the channel
  command Write and INA from the channel

- A write edit command not immediately preceded by a backward space block edit for the same tape unit.

- from central processor a CIO start with an invalid command on the BOU lines.

A program error stops any data exchange.

6.3.6. Tape unit address

Bits 10, 9, 8 and 7 give the tape unit concerned by the status word.

Only one among these bits is set at a time.

6.3.7. Write ~~unable~~ disabled

This bit (6) is set wherever the control unit receives a write, write tape mark, or erase gap command, while the tape unit is file protected.

A write unable declaration stops any data exchange.

6.3.8. Load point

The selected tape unit is at load point.

6.3.9. End of tape

The end of tape area has been sensed, during the command performed. It is not memorized in the C.U. for the next command forward.

6.3.10. File mark

This bit is set if a file mark has been sensed or a file mark format has been detected with a data fault during a read or a space block command.

6.3.11. Rewinding

This bit is set if the tape unit selected is engaged in a rewind operation.

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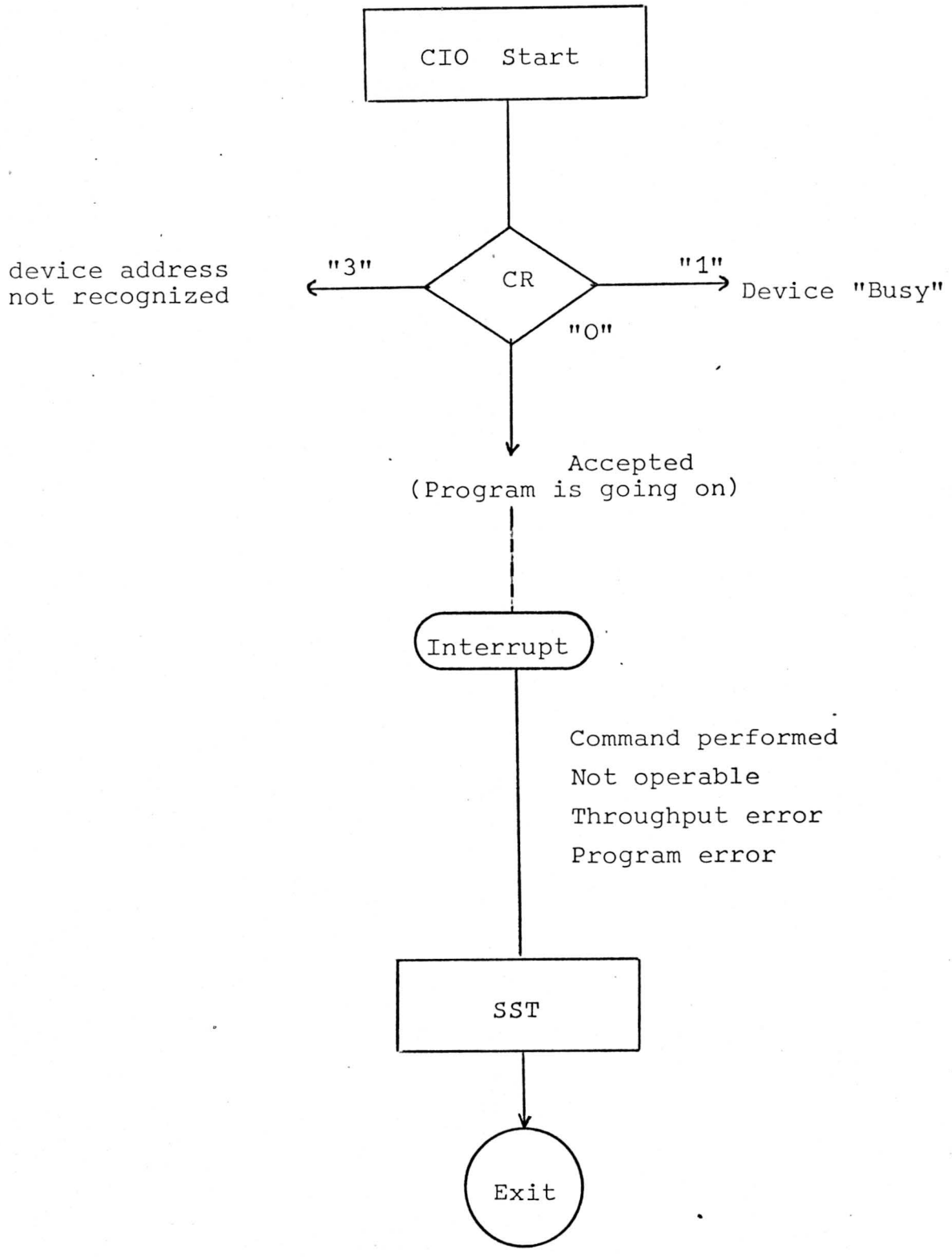
6.3.12. Was not ready

This bit is set when the state of a tape unit has changed from not ready to ready :

- after a complete rewind operation
- after a not operable status when a tape unit becomes operable.

6.4 Programming rules

6.4.1. Use of the I/O commands



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6.4.2. Interrupt activation

An interrupt activation happens when a CIO command has been accepted by the control unit or when the change from "not ready" state to "ready" state of a device is detected by the control unit.

An interrupt activation following a CIO command may occurs in three ways :

- CIO accepted and correctly executed
At the end of a command execution, the control unit activates the interrupt line asking for a status word exchange.
The status word is full of "0" except for the bit giving the tape unit number.

- CIO accepted and not correctly executed.
This is, for example, the case when a device becomes suddenly "not ready" during the command execution.
The interrupt activation, asking for a status word exchange, occurs after the tape is stopped.
The status word indicates what has happened.

- CIO accepted but not executed.
It may occur that a CIO command is accepted by the control unit but can not be executed (device "inoperable", Tape at load point, device "file" protected).
The interrupt activation occurs immediatly after the command has been accepted.

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6.4.3. Possible status configurations

```
15 : 1 0 0 0 0 0 0 0 0
14 : 0 1 0 0 0 0 0 0 0
13 : 0 X 0 X 0 0 X 0 0
12 : 0 0 0 0 0 0 0 0 0
11 : 0 0 0 1 0 0 0 0 0
10
 9 : Only one among these bits is set at a time
 8 :
 7
 6 : 0 0 0 0 1 0 0 0 0
 5 : 0 0 0 0 0 1 0 0 0
 4 : 0 X X 0 0 0 0 0 0
 3 : 0 0 0 0 0 0 1 0 0
 2 : 0 0 0 0 0 0 0 1 0
 1 : 0 0 0 0 0 0 0 0 1
 0 : 0 0 0 0 0 0 0 0 0
```

6.4.4. Miscellaneous informations

Once a rewind or off line has been started on one tape, any operation may be executed on another tape connected to the same controller.

It is not controlled by hardware whether the tape has already been written. Any read, space block or search command performed on a tape without information will make it run till the end or the beginning depending on the command direction. Any read, space block or search command forward performed after any write command is not permit but not controlled by hardware.

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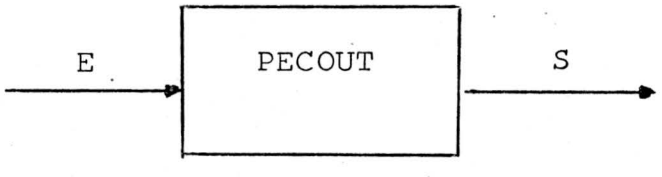
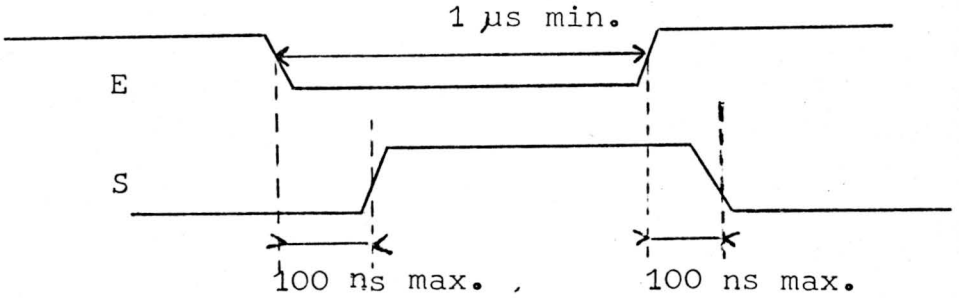
9 - SPECIAL CIRCUIT REQUIREMENTS

9.1 Output adaptator

Name Input	Name Output	Logical Function	FAN IN	FAN OUT
TADO	ITADO	Inverter	1 TTL	See
TAD1	ITAD1		74 N	Formatter
GO	IGO			
BUF5	IREV			
BUF7	IWRT			
WFM	IWFM			
EDIT	IEDIT			
ERASE	IERASE			
REW	IREW			
OFL	IOFL			
LWD	ILWD			
FEN	IFEN			
BUF0	IW0			
BUF1	IW1			
BUF2	IW2			
BUF3	IW3			
BUF4	IW4			
BUF5	IW5			
BUF6	IW6			
BUF7	IW7			



These signals are actif low and without power supply on the CU, PECOUT level output must be high.



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9.2. Input adaptator

Name Input	Name Output	Logical function	Fan In	Fan Out
IFBY	FBY	Inverter	See	8TTL
IDBY	DBY		Formatter	74 N
ICCG	CCG			
IHER	HER			
IFMK	FMK			
IRDY	RDY			
IONL	ONL			
IFPT	FPT			
ILDP	LDP			
IEOT	EOT			
IWSTR	WSTR			
IRSTR	RSTR			
IRP	RP			
IRO	RO			
IR1	R1			
IR2	R2			
IR3	R3			
IR4	R4			
IR5	R5			
IR6	R6			
IR7	R7			

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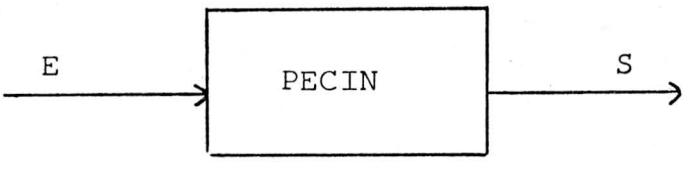
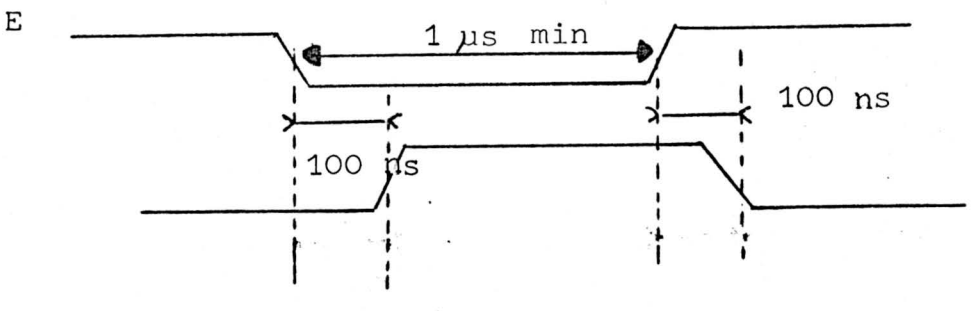


PECIN level output must be "low" when the power is off on the peripheric or when the interconnection cable is plugged out.



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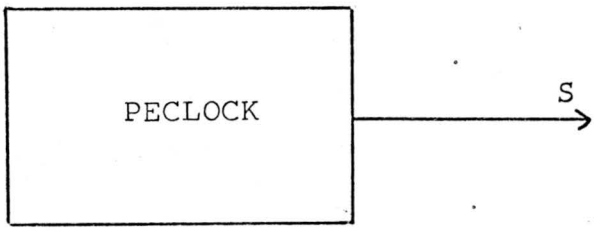
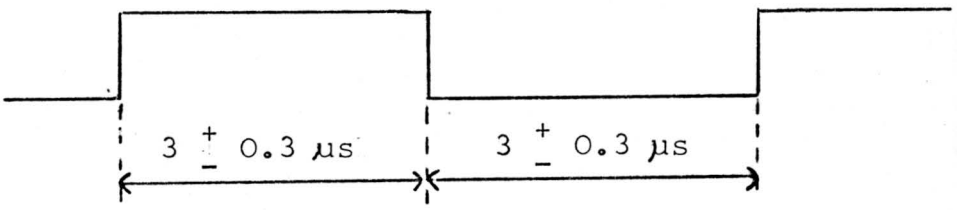
9.3. Special circuit clock pulse generator



Waveform



Fan out : 8 TTL 74 N located on one card.