I - SCOPE

The moving head disc control unit permits the connection of one or two X1210 disc drive unit(s) on the P855 or P860. The X1210 is a small random access mass storage using removable magnetic discs.

The total capacity is approximately 2.7 Mbytes; the records are organized in 6400 sectors of 210 words each.

I - APPLICABLE DOCUMENT

Engineering specification CN 070/03005/523 +

Disc drive unit X 1210

I - EXTERNAL LOGIC INTERFACE

1.1. Between the Control Unit and the C.P.U., the standard SAG interface

1.2. Between the Control Unit and the Disc Unit Signals

from the C.U. to the Disc Unit

- eight control bus lines
- difference select
- head select
- control select
- write data signal

Signals from the Disc Unit to the C.U.

- read data signal
- index signal
- sector signal
- unit unsafe
- unit ready
- on cylinder

PHILIPS

0. CONTENT

1. BASIC INFORMATION

1.1. Disc unit
1.2. Control unit

2. I/O INSTRUCTIONS

2.1. Seek command
2.2. Seek to zero command
2.3. Write a sector
2.4. Read a sector
2.5. SST command
2.6. Stop command
2.7. TST

3. PROGRAMMING RULES

3.1. Generalities
3.2. Execution time
3.3. Interrupts

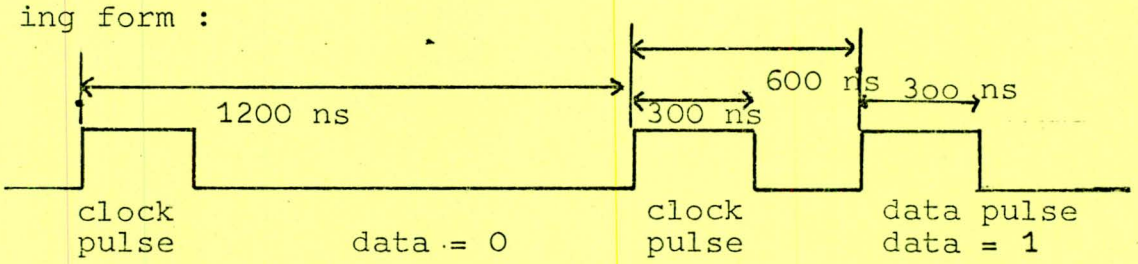
1. BASIC INFORMATION

1.1. Disc unit

General characteristics

Model	:	Philips X1210
number of cylinders in a dispack	:	200 + 34
number of tracks in a cylinder	:	2
number of sectors in a track	:	16
number of heads	:	2
serial data transfer rate	:	833,3 Kbits nominal at 800 rpm
average access time :		
- average head positioning time	:	125 ms
- latency	:	37,5 ms (half revolution time)
recording technique	:	double frequency

The information on the transmission lines has the following form :



Among the 406 tracks of a dispack 400 at least are good, 6 tracks may be defective.

capacity

The information on a discpack is organized in words of 16 bits.

The capacity of a sector is 210 words.

The maximum capacity of a discpack is 1,344 10^6 words.

1.2. Control unit

The moving head disc control unit allows to connect two disc units to the C.P.U. via the Multiplex (or Simplex) channel.

The number of these two units is given by the bit of the DA field in the concerned I/O instructions

DA	
00 XXXX	: unit 0
01 XXXX	: unit 1

XXXX = control unit address

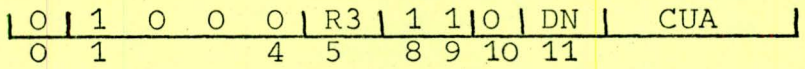
The control unit includes a serializer/deserializer for the information going to or coming from the disc unit. It controls the transfer of the information between the disc unit and the CPU and also performs and controls all the commands available on the disc unit.

The write and read operations are checked by a check-word. When writing, an "exclusive OR" of all the words of the record taken successively is computed and written as last word of the record. When reading, another check-word is computed and compared with the last word of the record which is not transferred to the C.P.U. If they are different, it is signalized in the status word as data fault.

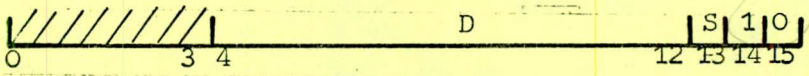
2. I/O INSTRUCTIONS

2.1. Seek command

CIO format :



BOU (R3 contents) :



R3 :
The bits of this register specify the command and the function sent via the BOU lines.

C.U.A.: Control Unit Address
D : Difference between cylinder numbers (absolute value)
S : Direction of the motion
1 = towards the inner track (FORWARD)
0 = towards the outer track (REVERSE)
D.N. : Device number
XXXXX : Not significant

This command is used to move the heads from one cylinder to another one. The cylinders are numbered from zero (outer track) to 203 (inner track).

This command is accepted if theControl Unit is in "inactive state", and if no seek is being executed on the concerned disc unit.

If the command is accepted :

- The condition register is set to zero.

- The control Unit switches to the "execute state"

- The control unit takes from the BOU lines the difference between the new cylinder number and the old one

- Then, the control unit switches back to inactive state and the seek itself is performed.

- At the end of the seek, an interrupt is sent in order to ask for a SST instruction

If the command is not accepted the condition register is set to one and nothing happens in the Control Unit.

If no control unit recognizes the address of this command, the condition register is set to the CR = 3 value (controller unknown).

If the operation is not possible : new number of cylinder greater than 203 or smaller than zero the commands is accepted and the C.U. switches to the "Send Status State". The bit 6 (seek error) of the status word is set. The disc unit becomes unsafe ; the FAULT indicator is lighted and it is necessary to stop and restart the unit for normal operation.

Security for the seek operation

The first word of each record will be an identifier. It will contain the cylinder number.

When reading, after a seek operation, it is possible to check that the seek has been done safely by reading the identifier.

Before writing after a seek operation, it is possible to check that the seek has been done safely by reading the identifier of the sector preceeding the sector to be written.

If this operation is successfull, it is possible to perform the normal operations on this cylinder with two precautions :

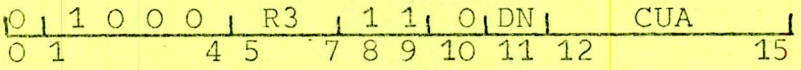
1. when reading, the first word is not a data word, but the identifier
2. when writing, the identifier must be the first word of the record.

This procedure asks for writing the identifiers on the disc pack the first time it is used. A special program will write the identifiers on each sector, from sector "0" of the cylinder "0" to the sector "31" of the cylinder "202". This can be done by the normal write operation with the only identifier word in the data field.

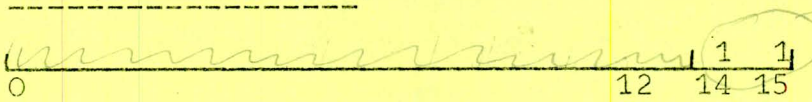
Then, this program will read the identifiers of the sectors in the same order than during the writing operation and check that all is correct.

2.2. Seek to zero command

CIØ :



BOU (R3 contents) : seek to 0



R3 : the bits of this register specify the function sent via the BOU line

C.U.A. : Control Unit Address

D.N. : Device Number

xxx : Not significant

This command is used to move the heads from any cylinder to the cylinder number zero.

This command is accepted if the Control Unit is in the "inactive state", and if no seek is being executed on the selected disc unit.

If the command is accepted :

- the condition register is set to zero
- the Control Unit switches to the "execute state" and then, after the operation is started, switches back to inactive state
- the control unit moves the heads to the cylinder number zero
- at the end of the seek, an interrupt is sent in order to ask for an SST instruction.

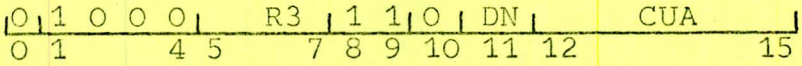
If the command is not accepted the condition register is set to one and nothing happens in the Control Unit.

If no Control Unit recognizes the address of this command the condition register is set to the CR = 3 value (controller unknown).

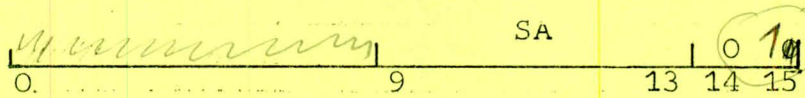
The precautions used in a normal seek to check this operation have to be taken also for this command.

2.3. Write a sector

CIO format



BOU (R3 contents)



R3 : the bits of this register specify the command and the function sent via the BOU lines

C.U.A. : Control Unit address

S.A. : Sector Address from 0 to 31

D.N. : Device number

mm : Not significant

This command is used to start a write operation on the sector addressed on the BOU lines, on the cylinder selected at the moment this command is used.

This command is accepted if the Control Unit is in the "inactive state", and if no seek operation is being excuted on the concerned disc unit.

If the command is accepted :

- the condition register is reset
- the Control Unit switches to the "execute state"

The Control Unit takes from the BOU lines the address of the sector and performs the operation by sending

break signals via the multiplex channel. At the end of the data exchange, an interrupt is sent to the computer.

If the command is not accepted, the conditions register is set to one and nothing happens in the Control Unit.

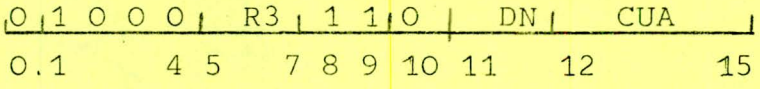
If no Control Unit recognizes the address of this command, the condition register is set to the value CR = 3 (controller unknown).

If a throughput error occurs during a write command, the data transport is interrupted, the C.U. goes to the "Send status" state. The bit 14 (throughput error) of the status word is set.

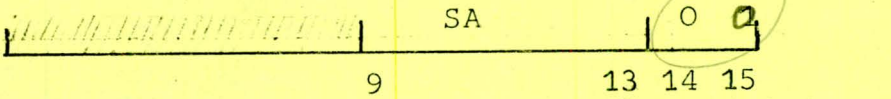
Nota : The record to be written is of variable length between 1 till 210 words. If an attempt is made to write a longer record, the data exchange is stopped when the physical end of the sector is reached (§ Status configuration).

2.4. Read a sector

CIO format



BOU (R3 Contents)



R3 : the bits of this register specify the command and the function sent via the BOU lines.

C. U. A. : Control unit address

S. A. : Sector address from 0 To 31

D. N. : Device number

[illegible] : not significant

This command is used to start a read operation on the sector which is addressed on the BOU lines, on the cylinder selected at the moment this command is used.

This command is accepted if the control unit is in the "Inactive state", and if no seek operation is being executed on the concerned disc unit.

If the command is accepted :

- The condition register is reset
- The control unit switches to the "Execute state".

The control unit takes from the BOU lines the address of the sector and performs the operation by sending break signals to the Multiplex channel. At the end of the data exchange an interrupt is sent to the computer.

If the command is not accepted, the condition register is set to one and nothing happens in the Control Unit.

If no Control Unit recognizes the address of this command, the condition register is set to the CR = 3 value (controller unknown).

If a parity error occurs during a read operation, a check work error is detected and the bit 13 (Data fault) of the status word is set.

If a throughput error occurs during a read command, the data transport is interrupted, the C.U./ switches to the "Send status" state. The bit 14 (throughput error) of the status word is set.

2.5. SST Command

Format

0	1 0 0 1	R 3	1 1	0	X	C U A
0	2	4 5	7 8	9	10	11 15

C.U.A. : Control Unit address
X : Not significant
R3 : register into which the status word is sent

This command is used to perform the exchange of status between the Control Unit and the C.P.U.

It is accepted if the Control Unit is in the "Send Status" state.

If the command is accepted :

- the condition register is reset
- the status word is sent on the BIN lines
- the status word is reset in the Control Unit
- the Control Unit switches to the "Inactive state".

If the command is not accepted, the condition register is set to one and nothing happens in the Control Unit.

If no Control Unit recognizes the address of the command, the condition register is set to the CR = 3 value.

STATUS CONFIGURATION

During an accepted Send Status command, the bits of the BIN lines have the following meaning :

BIN	15	Not operable
	14	Throughput error
	13	Data fault
	12	Incorrect length
	11	Program error
	9	Disc unit number
	8	Reserved
	7	Reserved
	6	Seek error
	5	On cylinder
	4	Reserved
	3	Reserved
	2	Reserved
	1	Disc unit ready after unready

STATUS Set conditions

- the bit 15 is set if it is attempted to execute an I/O program on a not operational device

- the bit 14 is set if the channel does not answer an exchange request in the allowed time during a read or write operation.

- the bit 13 is set if a check word error is detected or if a bad synchronization happens during a read operation.

- the bit 12 is set if the channel length is different from the record length during a read operation or if the end of a sector is found before the end of the exchange when writing.

- the bit 11 is set if :

A Multiplex out (bit 1 of the 1st control word = 0)is executed after a read command.

A Multiplex in (bit 1 of the 1st control word = 1) is executed after a write command.

- The bit 9 is zero if the information concerns the disc 0

- The bit 9 is one if the information concerns the disc 1

- Bits 8, 7 : reserved

- the bit 6 is set if the seek operation is finished but was impossible to execute correctly (cf. seek command) or if the disc unit becomes not operable during a seek operation.

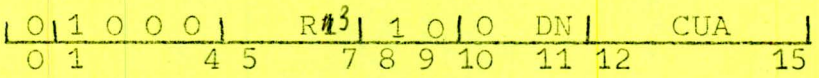
- the bit 5 is set if the seek operation is correctly executed.

- bits 4, 3, 2 : reserved.

- the bit 1 is set when the disc unit becomes operable.

2.6. Stop command

CIO - Format



R1 : not significant
C.U.A. : control unit address
D.N. : device number

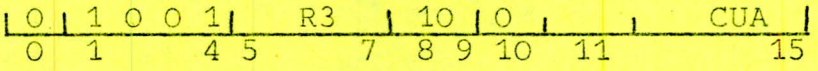
This command is used to stop any transfer of data between the disc Control Unit and the C.P.U.

When it happens while a read or write operation is executed the interrupt that normally follows the end of these operations occurs immediately.

This command is always accepted if a Control Unit recognizes the address and the condition register is set to zero. If no Control Unit recognizes the address, the condition register is set to the CR = 3 value.

2.7. TST Command

Format



R3 : indicates the register into which status is loaded during the instructions

CUA : control unit address

This instruction may be used before starting any I/O operation to test if the control unit is not busy.

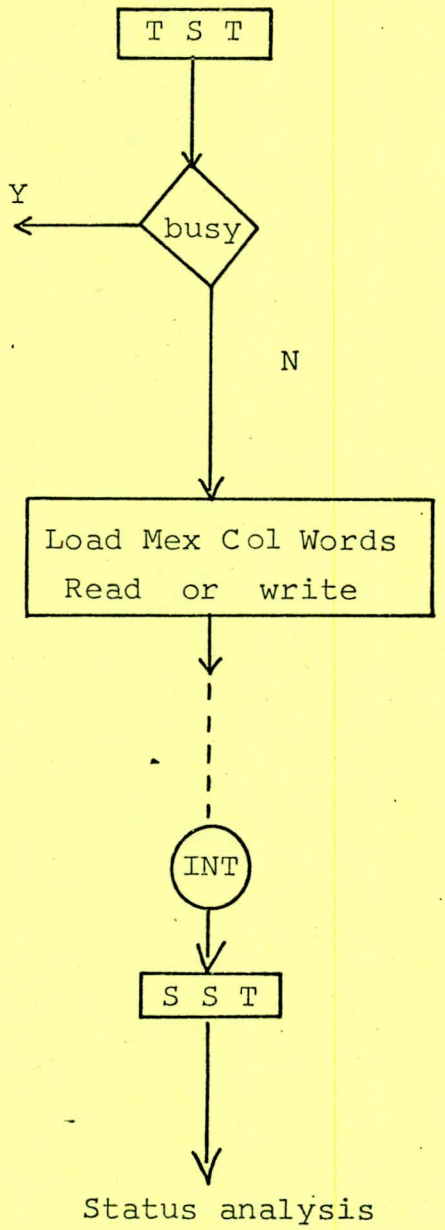
It is always accepted by the control unit.

During the execution of the TST, the BIN contents are sent into R3 register. A one bit in position 15 indicates the control unit is busy.

Other bits are not significant.

3. PROGRAMMING RULES

3.1. General diagrams



- Once a seek operation has been started on one disc unit, a new operation read,write or seek may be executed on the second disc unit connected to the same control unit.

Later on when the seek is finished there will be an interrupt and the status will tell the result of the seek (cf. status configurations).

3.4.2. Execution time of a command

Execution time of a seek command

Seek operations : one cylinder moves to be fixed
203 cylinders move to be fixed
Average access time 125mesc.max.

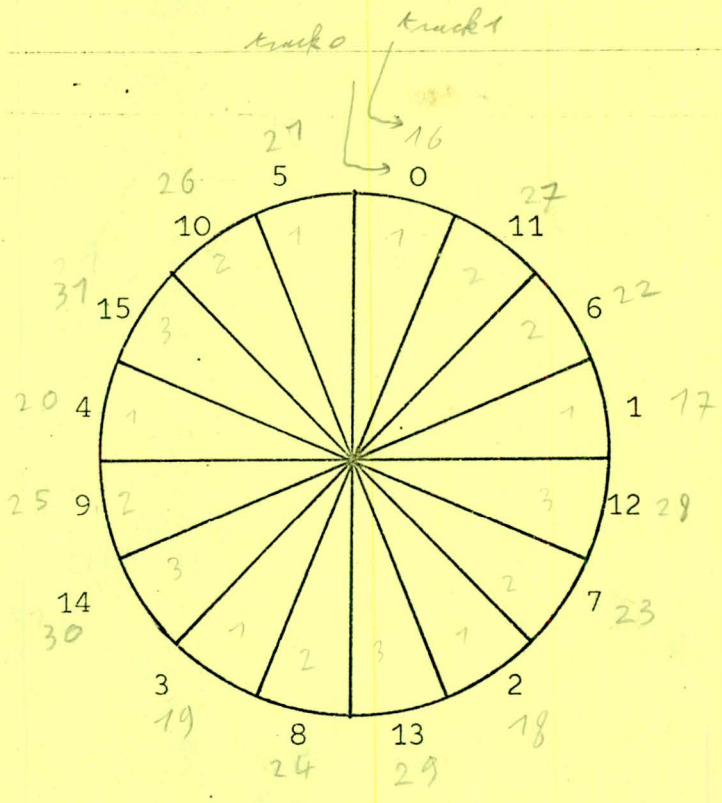
The average access time is defined as equal to the summation of the times of all possible moves devided by the number of the moves.

Execution time of a read or write command

The time necessary to execute a read or write command is given by the following chart when supposing the heads are ~~at the right place~~ on the right cylinder (no seek time is taken into account in the chart).

On this chart,

- the times are given in number of revolutions necessary to perform the operation ; the real time is got in multiplying the number given in the chart by 75 ms (revolution time).
- the times given to read or write n sectors are calculated supposing the sectors are interlaced.



Numeration of interlaced

sectors on a track

		Minimum	Maximum
Read 1 sector	normal	$\frac{1}{16}$	$1 + \frac{1}{16}$
	after a seek	$\frac{1}{16}$	$1 + \frac{1}{16}$
	after a commutation of drives	$\frac{1}{16}$	2
	after both	$\frac{1}{16}$	2
Write 1 sector	normal	$\frac{1}{16}$	$1 + \frac{1}{16}$
	after a seek	$\frac{2}{16}$	$1 + \frac{2}{16}$
	after a commutation of drives	$\frac{1}{16}$	2
	after both	$\frac{2}{16}$	$2 + \frac{1}{16}$
Read n sectors	normal	$\frac{3n - 2}{16}$	$\frac{3n + 14}{16}$
	after a seek	$\frac{3n - 2}{16}$	$\frac{3n + 14}{16}$
	after a commutation of drives	$\frac{3n - 2}{16}$	$\frac{3n + 29}{16}$
	after both	$\frac{3n - 2}{16}$	$\frac{3n + 29}{16}$
Write n sectors	normal	$\frac{3n - 2}{16}$	$\frac{3n + 14}{16}$
	after a seek	$\frac{3n - 1}{16}$	$\frac{3n + 15}{16}$
	after a commutation of drives	$\frac{3n - 2}{16}$	$\frac{3n + 29}{16}$
	after both	$\frac{3n - 1}{16}$	$\frac{3n + 30}{16}$

3.3. Interrupt

An interrupt will happen in two cases:

- after an accepted command to give the result of this command
- when a disc unit becomes operable after being not operable.

In both cases it must be followed by a Send Status command. The status will then specify the cause of the interrupt and the disc unit concerned by this interrupt (bit N° 9)

After an accepted command the status will indicate :

- if this operation was impossible for "not operable reason" (bit 15)
- if a read or write operation was not performed correctly (bit N° 11, 12, 13, 14).
- the result of a seek operation (bit n° 5,6)
- when a disc unit becomes operable after being not operable the bit n° 1 is set.
- after a read or write operation that was performed correctly only the bit N°9 will be set for the disc number 1.

- if two operations are done simultaneously (a read and a seek, two seeks...) there will be two interrupts signaling the end of them.

After an interrupt the status may have one of the following configurations :

Bit nb.	bit value				
15	0	Ø	0	0	0
14	0	Ø	0	0	0
13	0	Ø	0	0	0
12	0	Ø	0	0	0
11	0	Ø	0	0	0
9	Disc unit number				
6	0	0	0	1	0
5	0	0	1	1	0
1	0	0	0	0	1
	(1)	(2)	(3)	(4)	(5)

(1) End of read write operation performed correctly

(2) End of read write operation not performed correctly

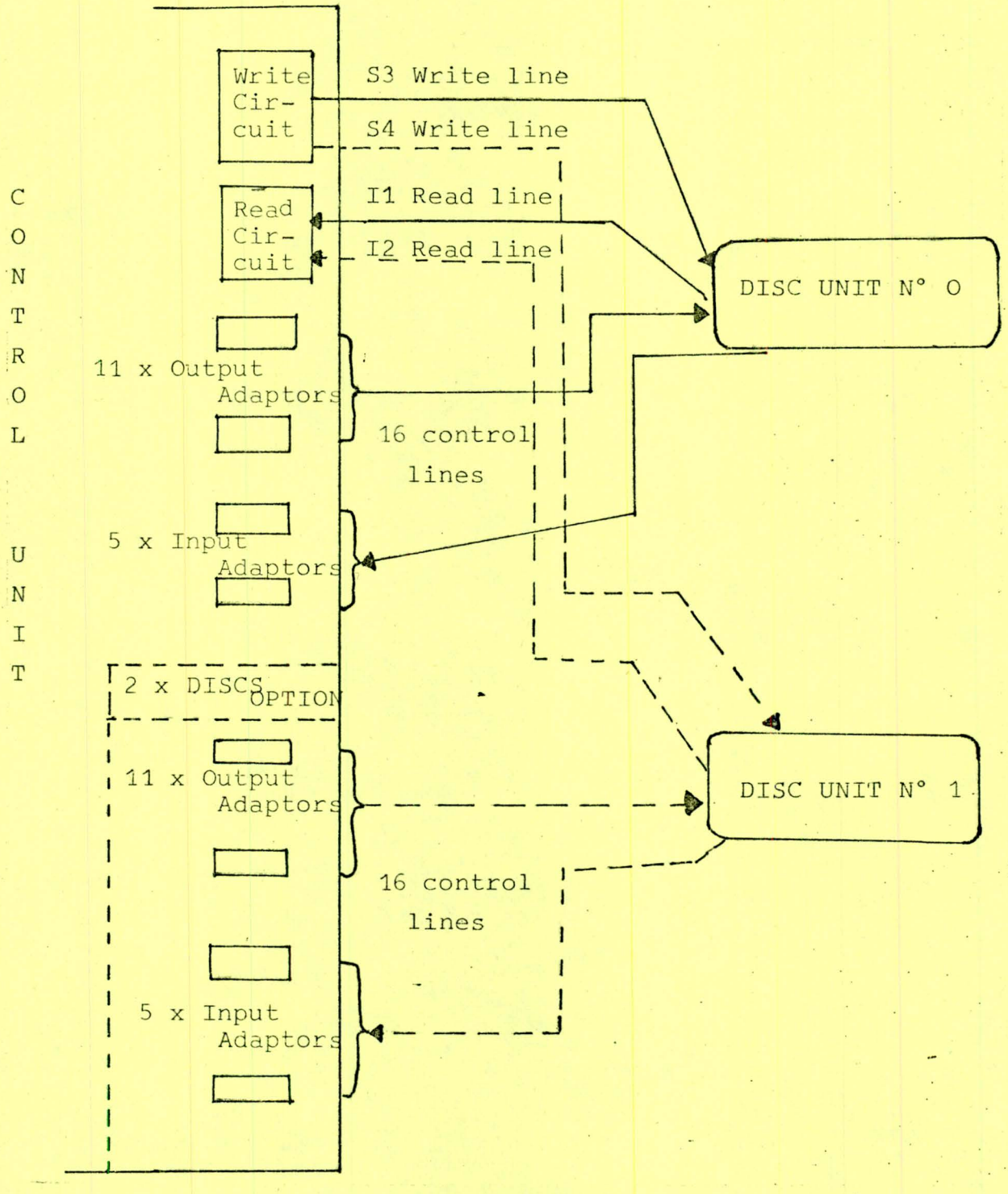
(3) End of seek operation performed correctly

(4) End of seek operation not performed correctly

(5) The disc unit becomes operable.

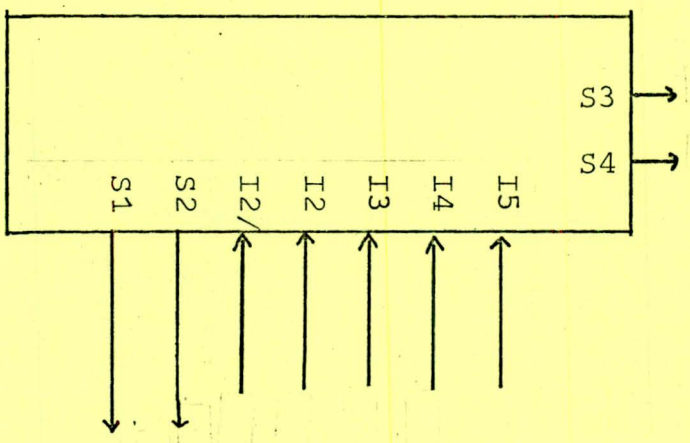
9 - SPECIAL CIRCUIT REQUIREMENTS

GENERAL DIAGRAM



9.1.Write circuits

9.1.1. General diagram



- S1 and S2 are clock pulses which are always present as soon as the power is on

- I2 is a selection signal (sent by the logic part of the controller) which allows to select the right "Write data line" (S3 or S4). I2/ is also provided.

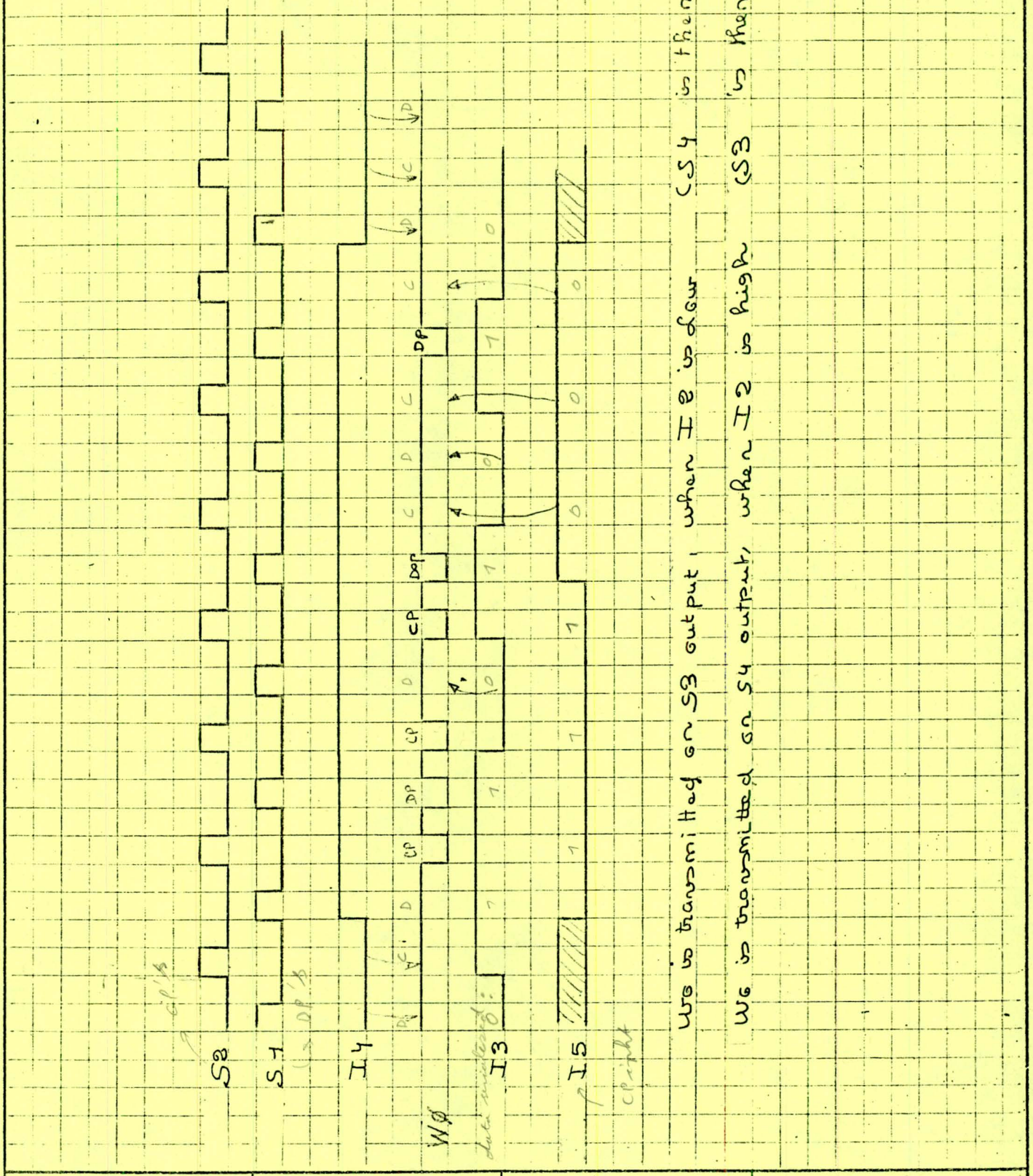
- I3 is a waveform which represents the output data from the serializer. I3 , concurrently with the I4 signal, is used to generate the WØ (i. e : S3 or S4) in the following way :

- As long as I5 is "low" - clock pulses (CP) are always generated, as shown in the diagram.

- Data pulses (DP) are generated according to the state of I3 signal, but caution must be taken to get always a CP as first pulse after the low to hight switching of the I4 signal.

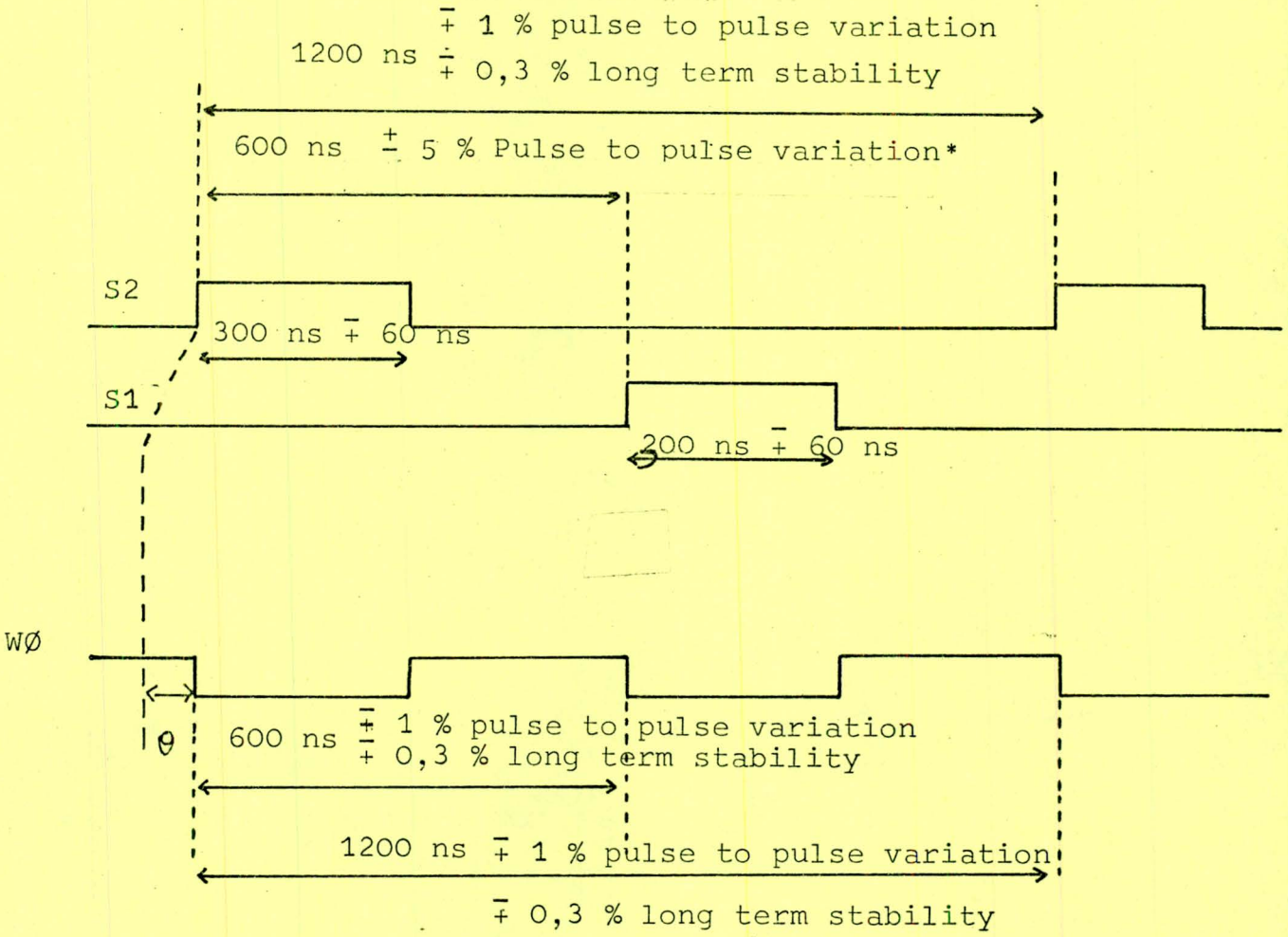
- When I5 is "high" CP pulses are inhibited.

9.1.2. Logical diagram



AUTHOR :	SIGNATURE	RESPONSIBLE	APPROVAL
BUNISSET		LEBRETON	COTTET

9.1.3. Output waveforms



- $-50ns \leqslant \theta \leqslant 50ns$
- All widths measured at 1.5 V.
- Rise and fall times must be $\leqslant$ 20 n S

*This tolerance is measured at Write Output circuit level.

9.1.4. Loading specification

9.1.4.1. Output

S1 : 30 TTL loads
S2 : 30 TTL loads
S3 : } Defined by Engineering specification X1210 *
S4 : } figure 3.13 page 3.20 data 70.07.08

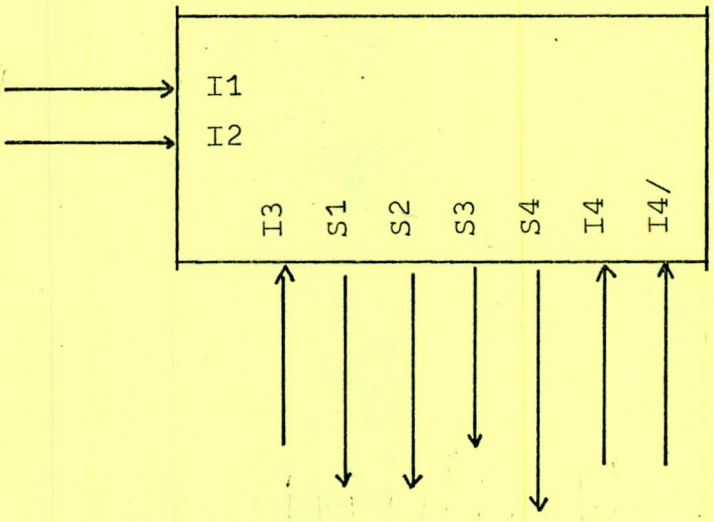
9.1.4.2. Input

I2/
I2
I3
I4
I5
} 1 TTL load

* Reference N° CN 070/03005/523

9.2. Read circuits

9.2.1. General diagram



- I1 and I2 are the Read Data Line coming from the disc units. They are selected with the I4 signal, in order to get one commun signal (RDL).

- S1 and S2 are respectively the data and clock pulses, needed for the logic part of the Control unit. They are generated in the following way :

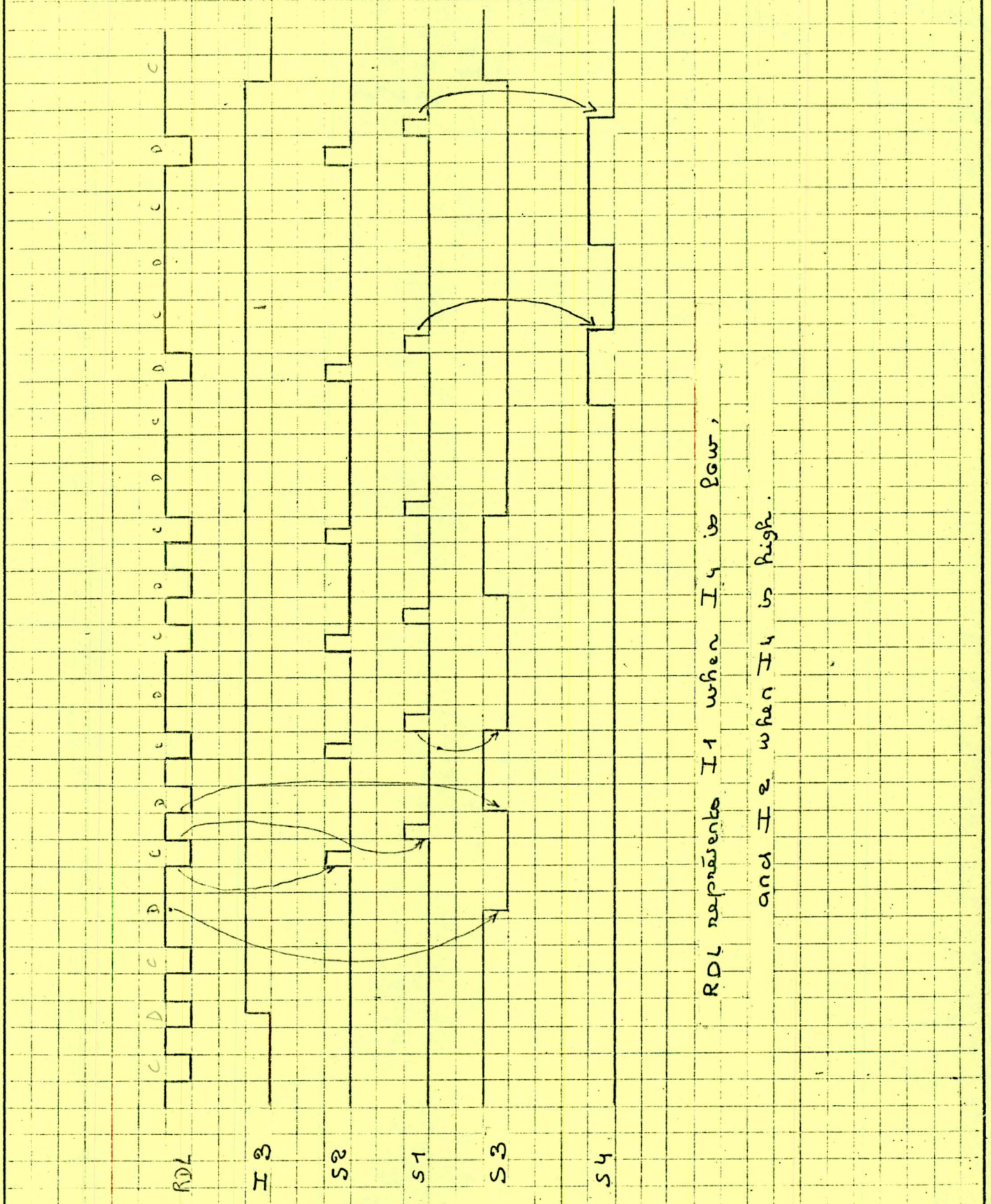
  When the I3 signal is high, the S2 signal remains low, until a "hole" is detected on RDL line : the first CP pulse is then obtained, from the high to low transition of RDL (C pulse). In the same way DP are generated from the low to high transition of C pulse. This is true until mis-sing pulse is detected (see following diagram).

- S3 - This signal gives the read data value : it is reset by the first "hole" detection, then by S1 , and it is set by D pulses from RDL.

- S4 is a signal generated when more than one RDL pulses are missing (hole larger than the first one). It is reset by the Trailing edge of S1

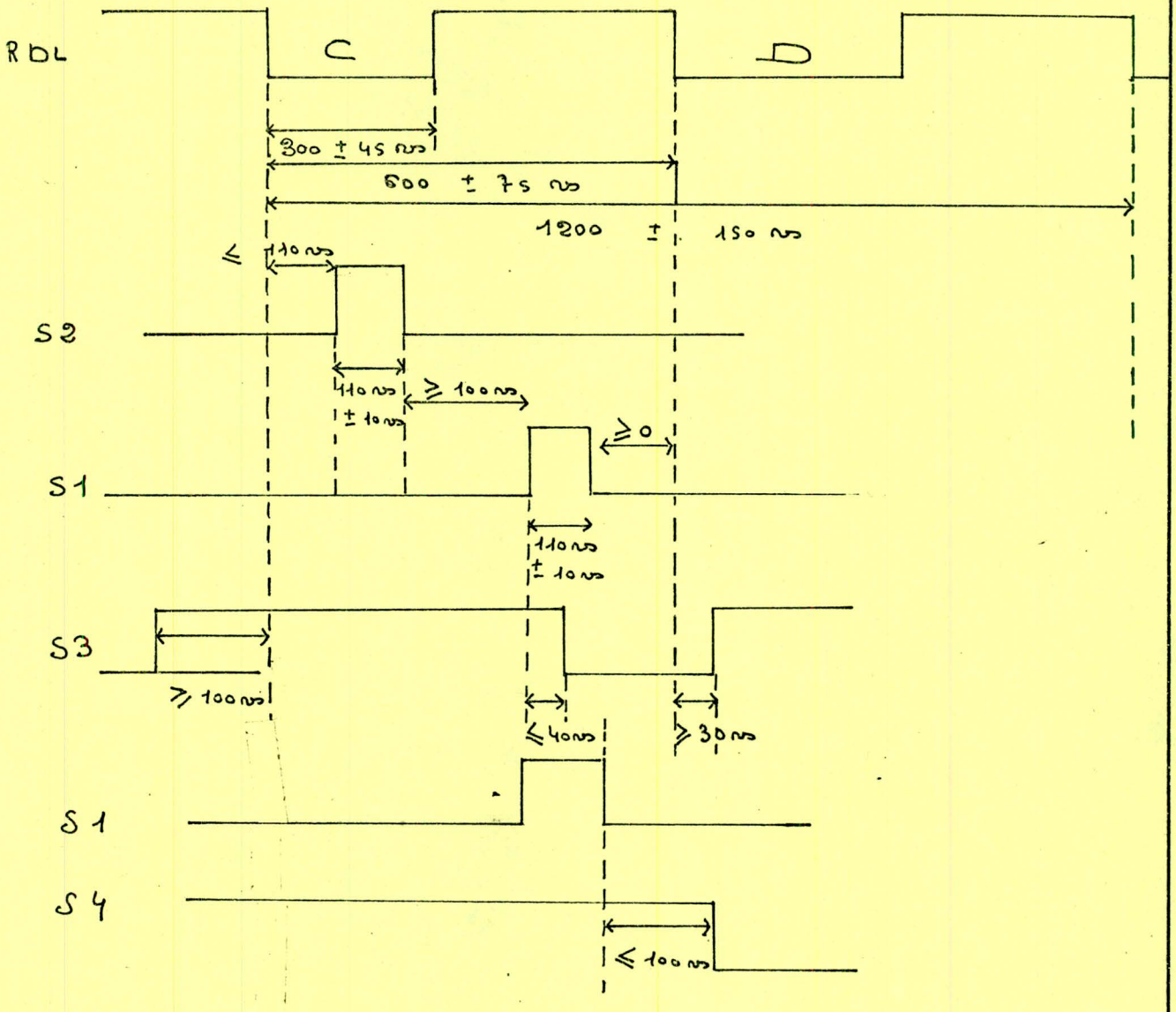
- When I3 is low ;
S1, S2 and S4 are low and S3 is high.

9.2.2. Logical diagram



AUTHOR :	SIGNATURE	RESPONSIBLE	APPROVAL
BUNISSET		LEBRETON	COTTET

9.2.3. Output waveforms



9.2.4. Inputs waveforms

Defined by Engineering specifications X 12101 Fig. 3.3. page 3.10 date 70.03.12 for I2 and I1.

*Reference N° CN 070/03005/523.

9.2.5. Loading specifications

9.2.5.1. Output

S2
S1
S3
S4 } 10 TTL loads

9.5.2.2. Input

I3 — 2 TTL Loads

I4
I4/ } 1 TTL Load.

I2
I1 } Defined by Engineering specifications X1210* fig. 3.13 page 3.20 data 70.07.08

*Reference N° CN 070/03005/523

9.3. Adaptation circuits

9.3. 1 - Output adaptor

There are 22 output adaptation circuits for control lines. 11 of them will be optionnaly wired if two disc units are required.

9.3. 2 - Input adaptor

There are 10 input adaptation circuits for control lines. 5 of them will be optionnaly wired if two disc units are required.
Both input and output adaptation circuits must fulfil the requirements specified in Engineering Specification of X1210 N° CN. 070/03005/523 - Fig. 3.14 page 3.21 date 70.07.08