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NEW PULSER FOR PRINCIPAL PO POWER

By G. Coudert

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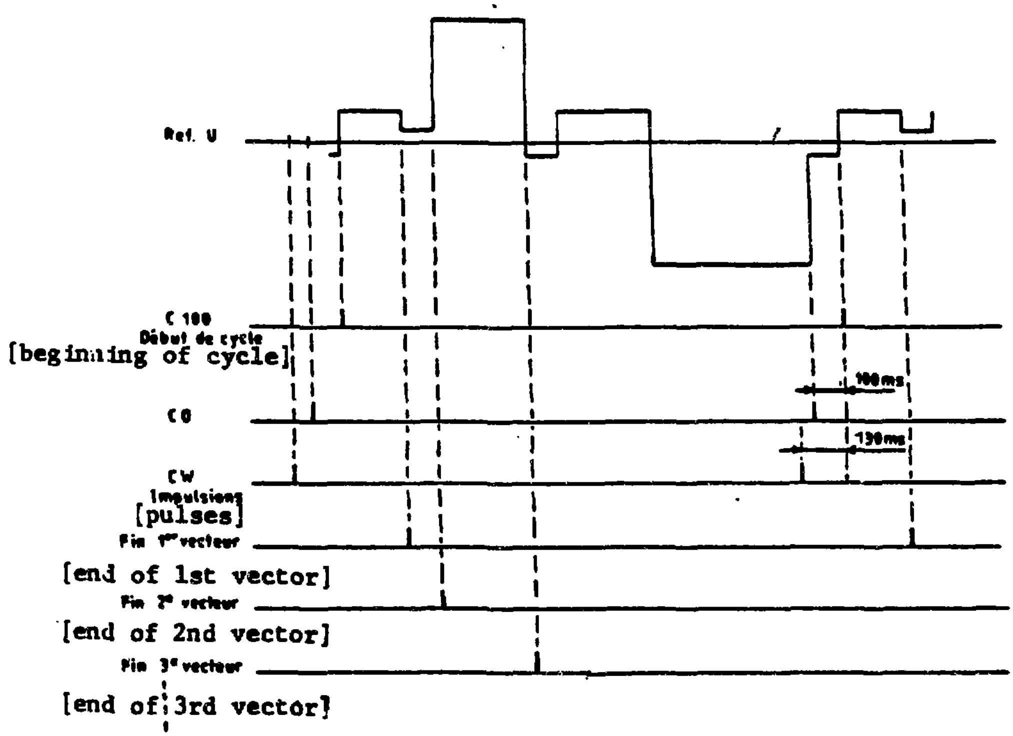
[Trans. note: In the following translation, words and acronyms that appear in all caps in the original French text will be copied as is, since they either represent actual commands or acronyms that are international in use, to the extent that can be determined. When a program contains commands in French, the translation of the command will be bracketed following the command.]

REVIEW: The pulser of the principal power of the PS is the unit that makes it possible to generate the reference function of the voltage of the principal magnet. This function depends on time and on the magnetic field of the magnet. It also generates various synchronization and reference pulses.



1. FORMER PULSER

This equipment made it possible to generate three types of reference voltages, or cycles (A, B, C) each composed of 8 vectors. Association of several cycles constituted the supercycle. It was composed of a maximum of 12 cycles (different or not). This equipment was composed of 12 baskets and any extension was practically impossible.

2. NEW PULSER

The new equipment is managed by microprocessor, so the present characteristics depend on the program and almost not at all on the equipment.

2.1. General Characteristics

2.1.1. Supercycle

Composed of a maximum of 69 cycles, it is defined by the following parameters:

TLCPS: Linac repetition rate

NBCYCLE: number of cycles in the supercycle;

GLISSE.: [Slip or float?] Limit value of float of the generator

COMPO.: Composition of supercycle (i.e. 2A, 1B, 2C)

2.1.2. Cycle

Five cycles of different types (A, B, C, D, E), each composed of 30 vectors (maximum). A cycle is defined in the following manner:

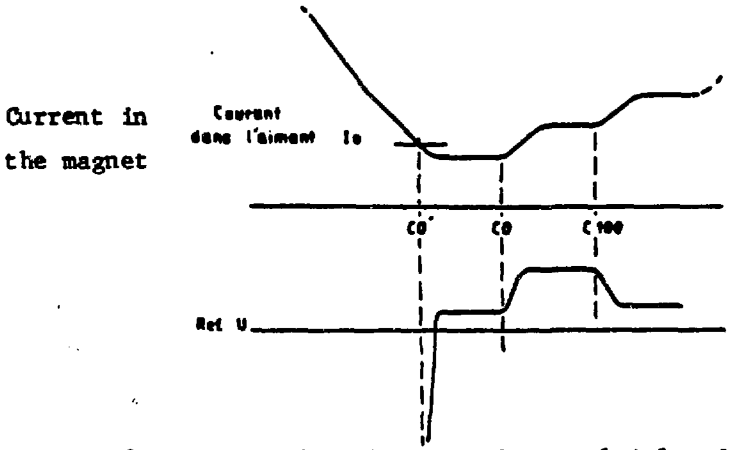
TYPE: A, B, C, D, D;

No CYC.: Record number of this cycle (i.e.: 101 corresponds to Cycle 10 GeV);

REF.P.MOY.: Value of the reference sent to the mean power regulation of the generator;

NBRE.VECTEURS: Number of vectors in the cycle

COURANT I_o: Value from which the drop of the principal current will be interupted in the "multi-pulsing" operation. Coincidence between the current in the magnet and the reference voltage I_o generates the pulse CO':



DUREE [duration] CYCLE: Value that must be a multiple of TLCPS.

VECTEURS: They are the following parameters:

ETIQUETTE [label]: Allows the end of vector pulse to be addressed on a line without taking into account the position of this vector in the cycle;

MODE DE DECLENCHEMENT [Triggering mode]: A voltage reference level is latched in during a given time, but for questions of reproducibility of the field in the magnet this reference must be switched to the following value if the field measured has reached its programmed value (see NIV.DEC.V); this requires definition of an interruption in time or in field;

DUREE VECTEUR: [vector duration] Maximum time during which the voltage reference level is latched in. At the end of this time, a vector end pulse is generated;

REF.TENSION [voltage]: Voltage reference level that will be latched in during the duration of the entire vector (except of an interruption of the field has been allowed and it has reached the programmed value before the end of the vector);

NIVEAU RAMPE [ramp level]: Switching of a REF.TENSION [voltage] level to another is done by a slope depending linearly on the value NIVEAU RAMPE (analog ramp limiter);

NIV.DEC.F: If the tripping mode of a vector is programmed at level B, when the measured field reaches the value of the B trip level, the coincidence pulse will switch the voltage reference to the next level.

2.2. Appearance and Composition of Pulser (see figure 1, a and b)

2.2.1. General Information

The pulser is composed of two distinct parts, a "machine" unit, an "operation" unit.

The hardward of the operation part is absolutely identical to that of the machine part. Communication with microprocessor (μP) equipment is different (direction of transfer), so it follows that there is a difference in the software.

The machine unit generates the references required by the principal power supply, by the magnet voltage regulator, by the motor power regulator. Therefore, it is directly linked to the machine.

The operation unit allows the operators to change the parameters during operation of the machine unit, to read the tripping mode of of the vectors, ... In addition, the operation part is linked to a simulation that will allow testing of the modifications of the parameters before transmitting them to the machine part without interrupting or disturbing the latter.

2.2.2. Pulser (fig. 1)

This equipment is in the form of two units: The microprocessor chassis (a) and the generator of reference functions and pulses (b).

a) Microprocessor chassis (fig. 2)

This unit corresponds to the Motorola system for micromodule cards. It is composed of a chassis that can accept ten cards, a power supply (+5 V, +12 V, -12 V), an interconnection bus. This chassis is equipped with a M68MM01A (μP6800, 1 MHz version) on which there is an EPROM containing the MICROBUG (M68MM86) monitor. The main program is on the 16 KO (M68MM04) EPROM card. The data tables are written on an 8 KO RAM (CERN-PS, B. Frammery) card. For the interface, two 8XP1A cards (CERN-EP, W. von Ruden) are used.

For the development of the various programs the CERN central development facilities were used (assembler, simulator, ... programs, see Appendix I). In order to load the "BINOUT" in our unit (RAM) with these assembled programs, the M6800-INDEX card equipped with the program allowing a CDC↔equipment dialog (see Appendix I) was used. This card is permanently mounted in the chassis in order, in the future, to allow these facilities to be retained and to use the routines that are in this program. In addition, this card is equipped (in the part reserved for user assembly,) with a logic circuit allowing a pulse to be generated when the equipment is powered to allow automatic initialization of the principal program.

b) The reference and pulse generator chassis (fig. 3)

It is in the form of a CIM 25543 chassis five units high in which various logic cards are found: preselection counter-countdown, pulse decoding, etc. and two analog drawers (two 16 bit DAC and two 8 bit DAC plus a 12 bit DAC).

2.3. Specific Characteristics

2.3.1. 1 kHz Clock (fig. 4)

This pulse line is derived from a 8.192 MHz quartz oscillator. It is adjusted with a precision of $\pm 10^{-6}$ and a stability on the order of $\pm 5 \times 10^{-9}$/24 hr.

2.3.2. Time unit (fig. 5)

The time units (used to give a DUREE [duration] cycle, DUREE VECTEUR [vector duration] cycle, IMPULSIONS D'AVERTISSEMENT [warning pulse] cycle) count down the DUREE value from the 1 kHz clock. The maximum capacity of these counters is $2^{16} - 1$, or 65535 ms. On these units there are two adjustable coincidences (generation of fixed pulses with respect to C100).

2.3.3. Tripping by level $\vec{B}$ (fig. 6)

This unit allows generation of a pulse when the value contained in the counter-countdown is equal to the value at the comparator input. The line of pulses that is counted (or counted down, depending on the direction of field variation) corresponds to line B 0.1 gauss. The precision of the trigger pulse corresponds to 0.1 G but the resolution of the comparison is adjustable to 1 G.

2.3.4. Voltage Reference, Ramp Level Reference (fig. 7)

Double 15 bit DAC (with sign) but in order to simplify the writing of programs, and therefore of operation, these references have been calibrated to have 1 LSB 1 mV, or:

1000 Points ⇒ 1000 V power ⇒ 1000 V reference.

The output noise is below 100 µV (f < 10 kHz) and the temperature coefficient is 2 ppm/°C.

2.3.5. Slip, Mean Power, I_o Current References

The first two references are generated by an 8 bit DAC (with sign), calibrated to obtain a resolution of 100 mV (±100 points ⇒ ± 10 V). The I_o current reference is generated by a 10 bit DAC (with sign), calibrated to obtain a resolution of 10 mV (±1000 points ⇒ ±10 V). In multi-pulsing operation, this resolution corresponds to 1 A.

Note

The various DACs used are of the "OFFSET BINARY" type:

$FFFF_H$ ⇒ -Ref
8000_H ⇒ 0 V
0000_H ⇒ +Ref .

2.3.6. Decoding of the various warning pulses (fig. 8)

All of these pulses are synchronous with the 1 kHz clock. The delay, < 1 µs, between these pulses and the clock is constant, whatever the type of cycle, since they are always generated by the same unit.

2.4. Operation

In order to learn the simplified operation of the pulser, see the supercycle flowcharts. For more details, consult the routions in the CDC memory. The names of these programs are:

- SCMAC
- CHMAC
- NMI
- SCOPE
- CHAROPE
- NMI2
- ORDI2

- START
- STOP

The procedure to follow to call them up is described in Appendix I.

2.4.1. Terminal Menu

It is presented in the following form:

1: Write in MICRO OPERATION
2: START MICRO OPERATION
3: LECTURE [read], CORRECTIONS
4: LECT.MICRO.MACH.MOD.DEC.VECT.[read microprocessing-machine vector trip mode]
5: CHARGEMENT [load] MICRO-MACHINE
6: START MICRO-MACHINE
7: STOP MICRO-MACHINE.

To run one of these choices, one has only to type the corresponding number (1 to 7) whose role can be explained as follows:

1 allows the cycle and supercycle tables to be written
2 starts the supercycle program which is in memory.
3 allows reading the various values in memore and correcting them if necessary.
4 (the microprocessing machine running a supercycle on the machine) sends the interruption mode for each vector: time or level (field).
5 gives the validation (transfer) of the tables in the operation-microprocessor to the machine microprocessor.
6 and 7 are self-explanatory.

2.4.2. Computer Command

Computer command will allow the equipment to be commanded in the future from the MCR, according to an exchange protocol that has been defined (see Appendix II). For the present, a "scooter" will allow this equipment to be replaced (see use procedure in Appendix III) and access to bulk storage in which many types of cycles are already stored.

3. CONCLUSION

Equipment like what has just been described, built using microprocessors, is by definition flexible and powerful. A condensed description allows only several advantages to be shown.

In conclusion, what can be said among other things is that the new pulser is more "spartan" (4 baskets), easier to use (considering the efficiency) and that it can evolve fairly easily.

-- The new pulser was placed in service in February 1982. There have been no problems so far.

-- I would like to thank R. Mosig who made it possible to complete this project, and J.P Riunaud and B. Frammery for their precious advice.

SUPERCYCLE, CYCLE FLOW CHART
MACHINE MICROPROCESSOR

Key:

a) BEGIN

b) Initializatior of peripherals

c) COMPUTER

d) Local (terminal)

e) Load sypercycle and cycle tables sent by operation microprocessor

f) Load sypercycle and cycle tables (see terminal menus)

g) START program

h) no

i) START COMMAND SENT?

j) yes

k) Cycle number in SC [supercycle?]

l) Run first cycle (then subsequent ones)

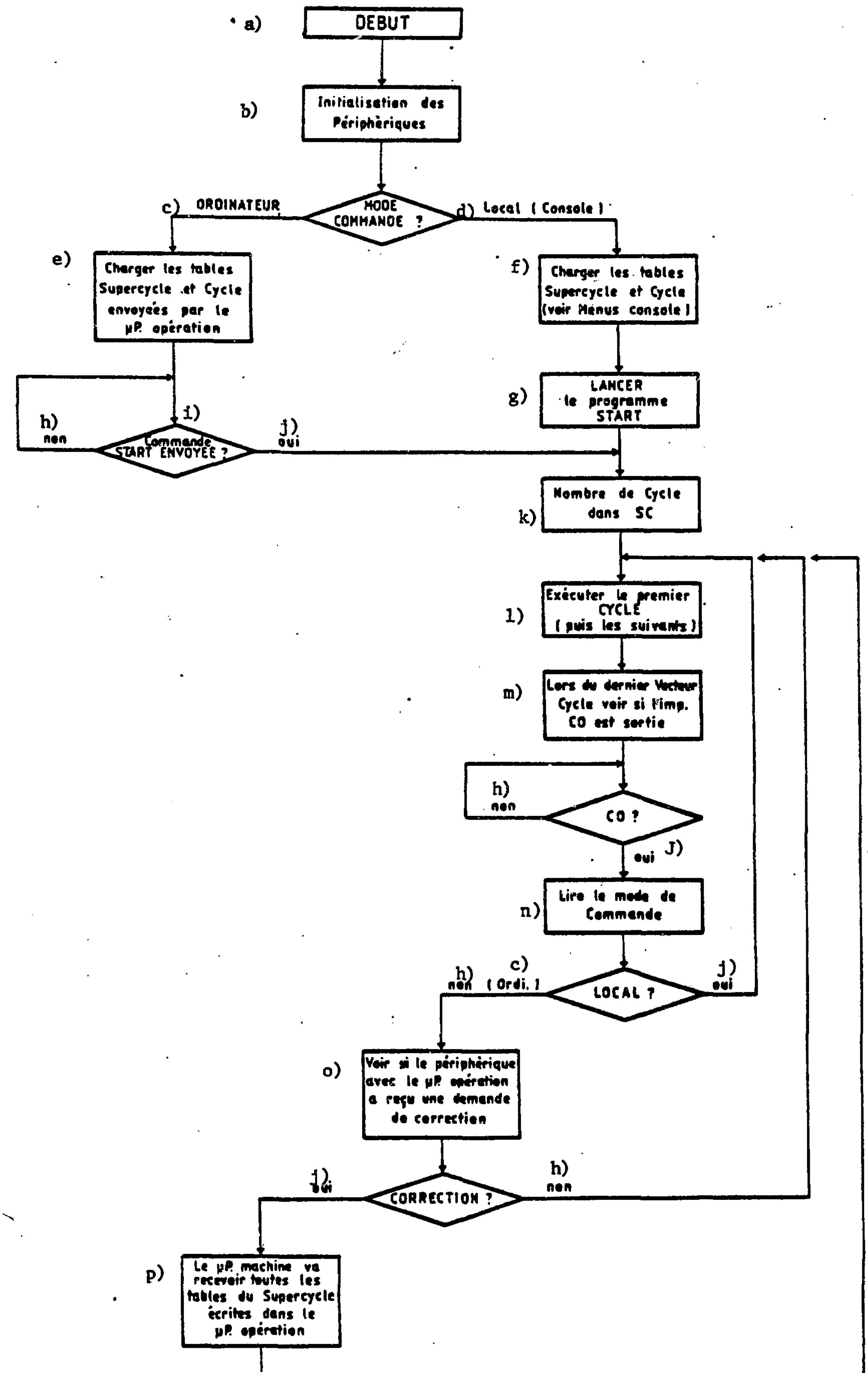
m) At last cycle vector, see if CO print has been output

n) Read command mode

o) See if the peripheral with the operation micrprocessor has received a request for correstion

p) The machine microprocessor will receive all the Supercycle tables written in the operation microprocessor

ORDINOGRAMME SUPERCYCLE, CYCLE MICROPROCESSEUR MACHINE

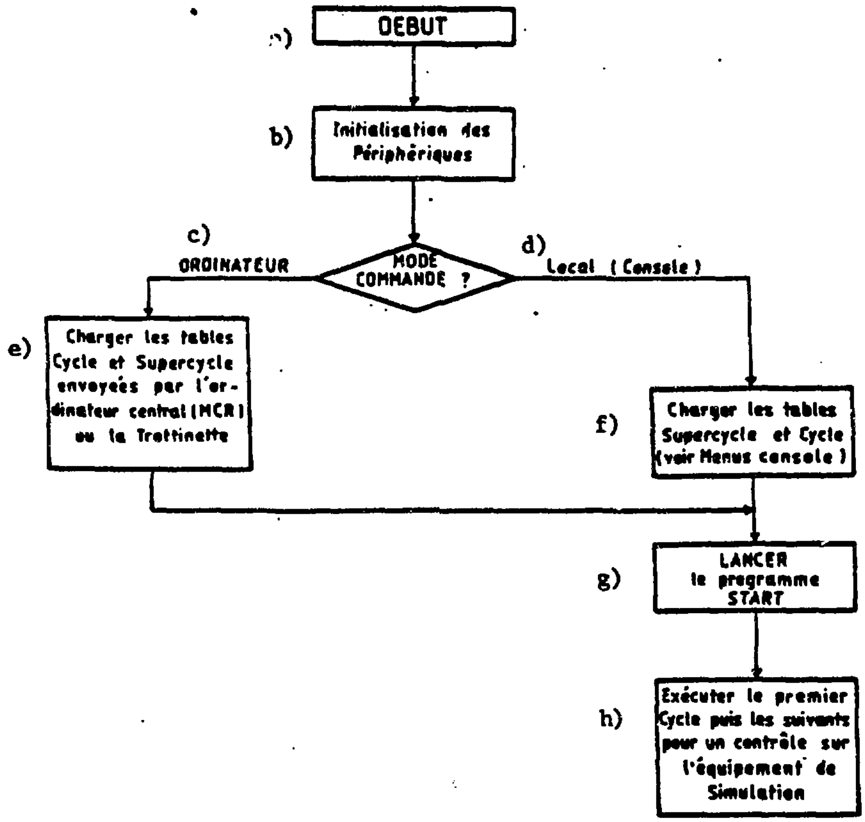


SUPERCYCLE, CYCLE INTERRUPTION FLOW CHART
OPERATION MICROPROCESSOR

Key:

a) BEGIN
b) Initialization of peripherals
c) COMPUTER
d) Local (terminal)
e) Load cycle and supercycle tables sent by central computer (MCR) or scooter
f) Load supercycle and cycle tables (see terminal menus)
g) START START program
h) Run the first cycle then subsequent ones to verify on simulation equipment
i) yes
j) READ?
k) no
l) Return to terminal menus
m) The operation microprocessor sends the table requested to computer
n) The operation microprocessor establishes the link with the machine microprocessor and gives START
o) Return to interrupted program
p) The computer sends a table
q) The operation microprocessor establishes the link with the machine microprocessor and gives STOP
r) Command START machine
s) The operation microprocessor runs a new sypercycle
t) ERROR message sent to computer
u) New SUPERCYCLE?
v) The operation microprocessor establishes the link to the machine microprocessor and sends all the tables of the supercycle to be run.
w) Wait for warning pulse SSC machine microprocessor
x) EXIT?

ORDINOGRAMME SUPERCYCLE, CYCLE, INTERRUPTION
MICROPROCESSEUR OPERATION



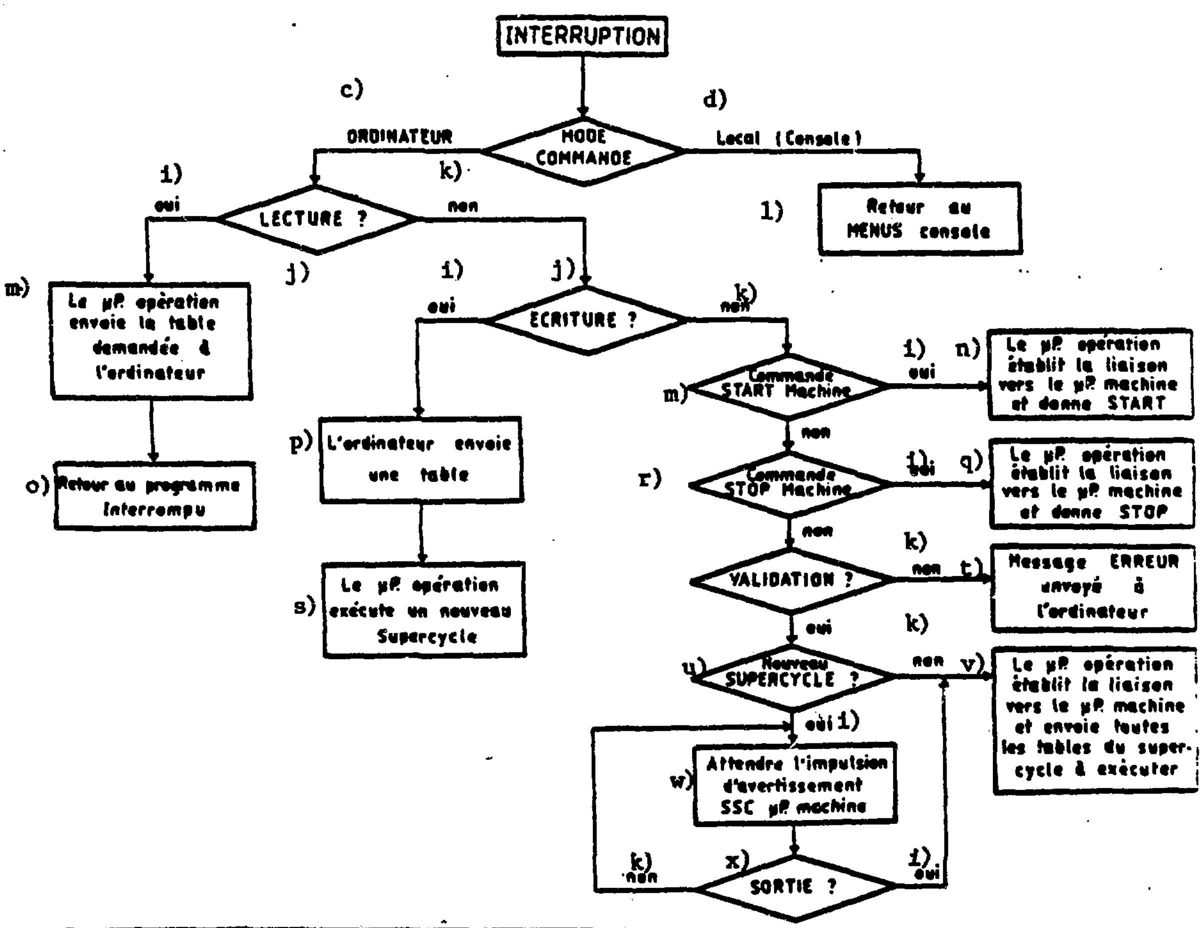


Fig. 1

BLOCK AND LINK SCHEME WITH THE NEW PO PULSER

Key:

a) ND10 or "scooter"

b) Central computer (IBM, CDC, ...)

c) Operation microprocessor

d) Machine microporcessor

e) Function generators (Ref. + Ptint vector end)

f) Function generators (Ref. + Print vector end)

g) Regulators (+ 0.1 G, I, B simulator)

h) Regulators (magnet voltage, mean P, BY-Pass Command)

i) Pulse repeaters

j) Pulse repeaters

k) Pulses from current pulser

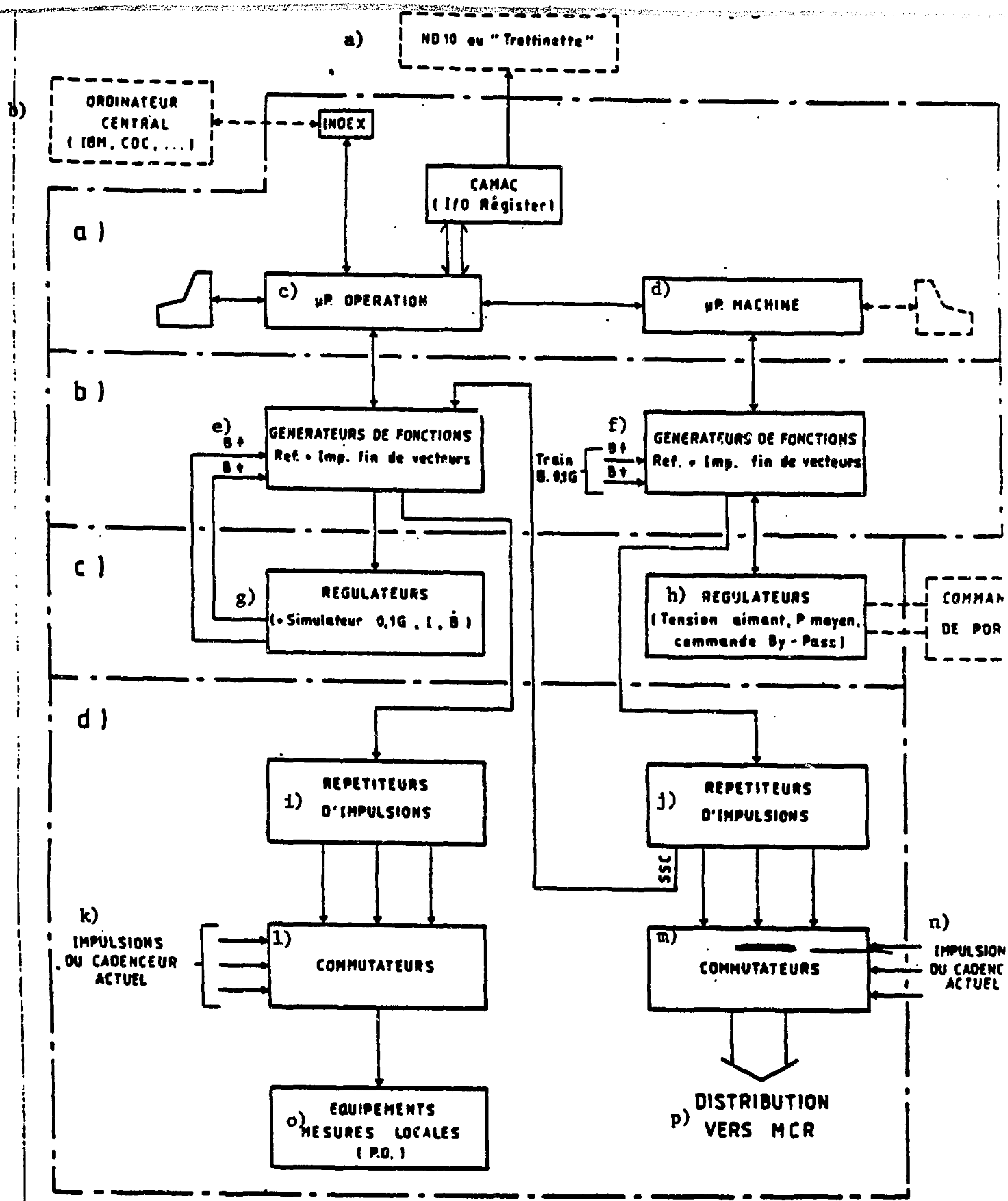
l) switches

m) Swithces

n) Pulses from current pulser

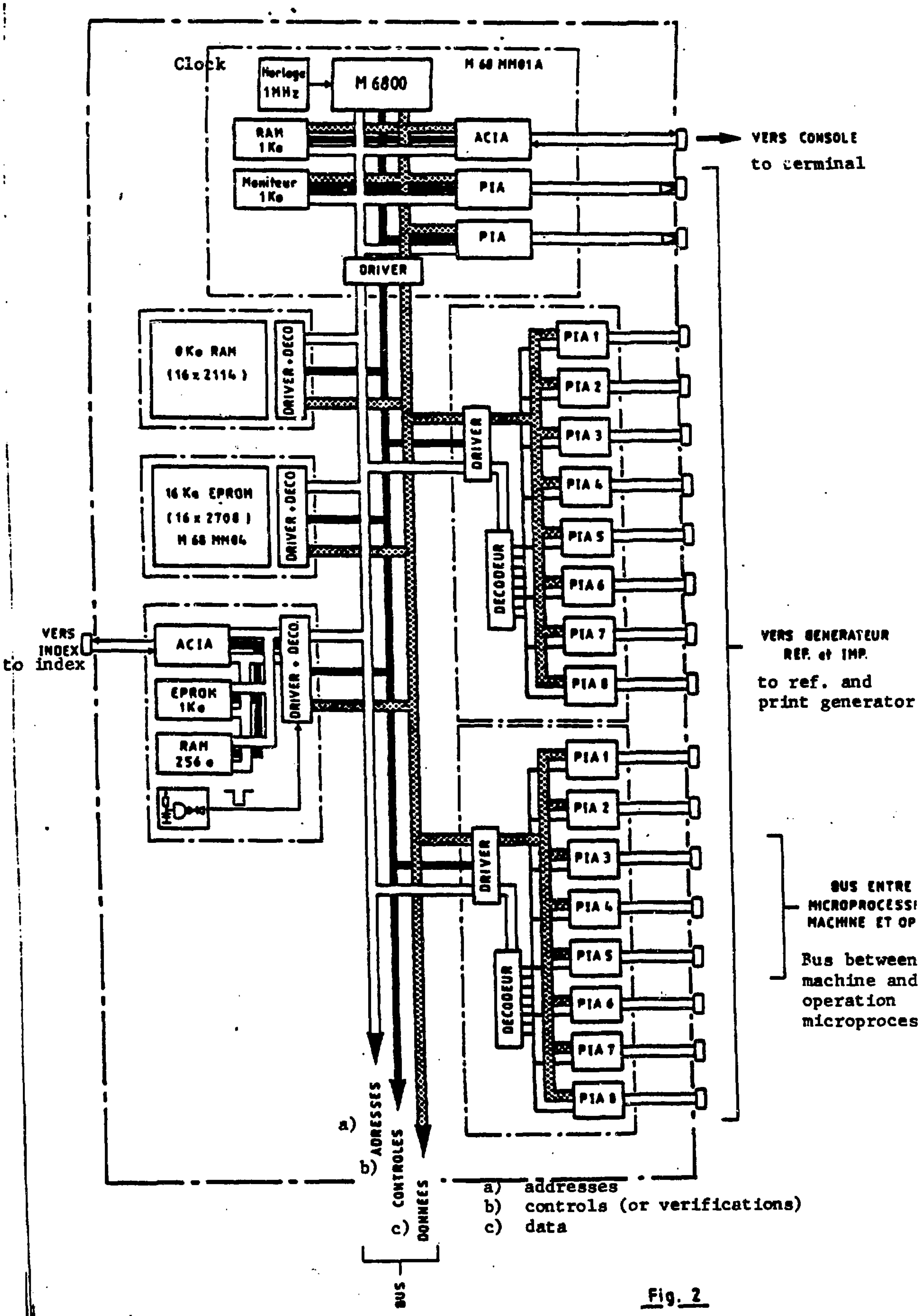
o) Local measurement units (P.O.)

p) Distribution to MCR



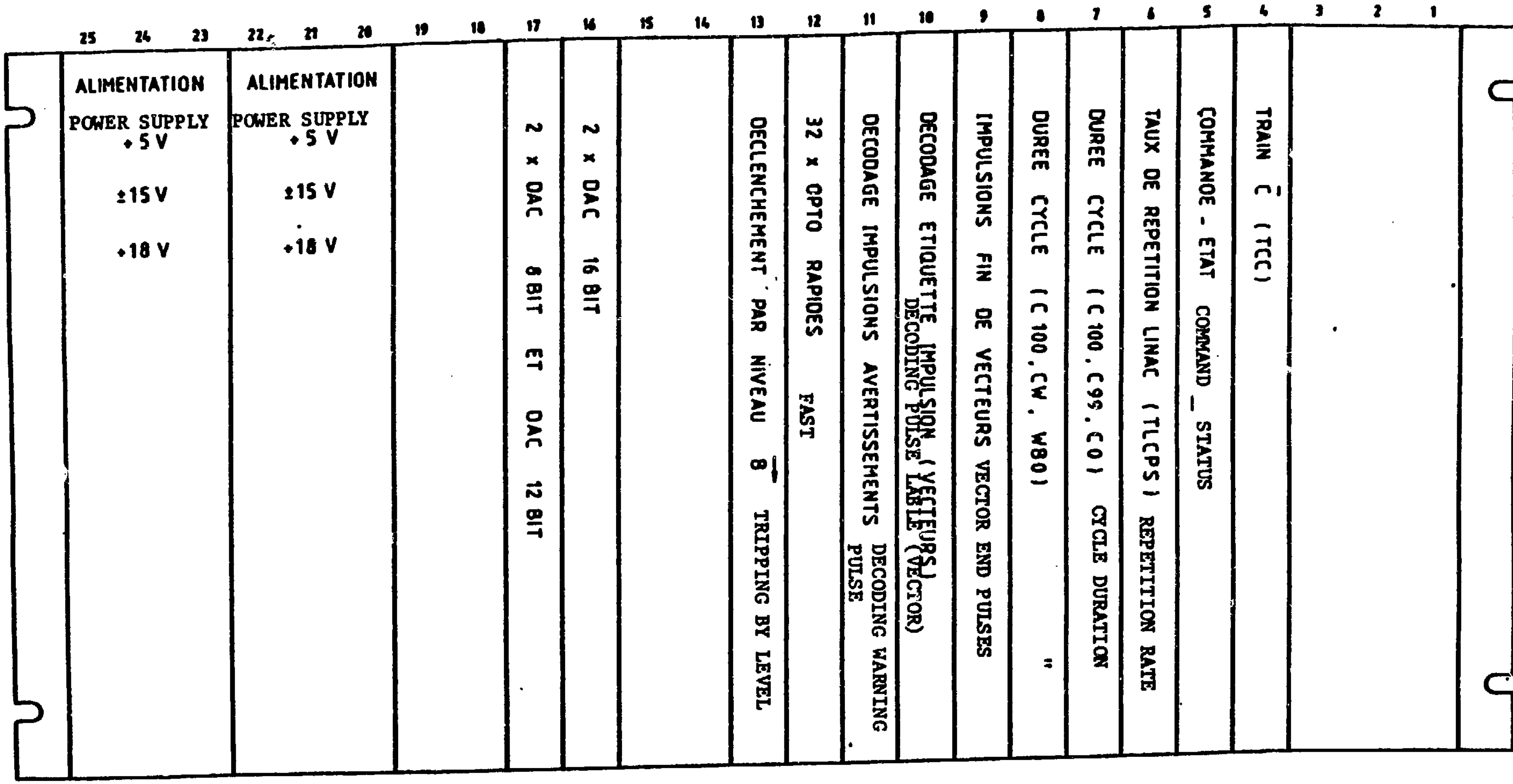
SCHEMA BLOC ET LIAISONS
AVEC LE NOUVEAU CADENCEUR P.O

Fig. 1



Clock
Horloge 1MHz
M 6800
M 68 MM01 A
RAM 1 Ko
Moniteur 1 Ko
ACIA
PIA
PIA
DRIVER
VERS CONSOLE
to terminal
8Ko RAM (16 x 2114)
DRIVER + DECO
16 Ko EPROM (16 x 2708) M 68 MM04
DRIVER + DECO
VERS INDEX
to index
ACIA
EPROM 1Ko
RAM 256 o
DRIVER + DECO
DRIVER
DECODEUR
PIA 1
PIA 2
PIA 3
PIA 4
PIA 5
PIA 6
PIA 7
PIA 8
VERS GENERATEUR REF. et IMP.
to ref. and print generator
BUS ENTRE MICROPROCESS MACHINE ET OP
Bus between machine and operation microproces:
a) ADRESSES
b) CONTROLES
c) DONNEES
BUS
a) addresses
b) controls (or verifications)
c) data

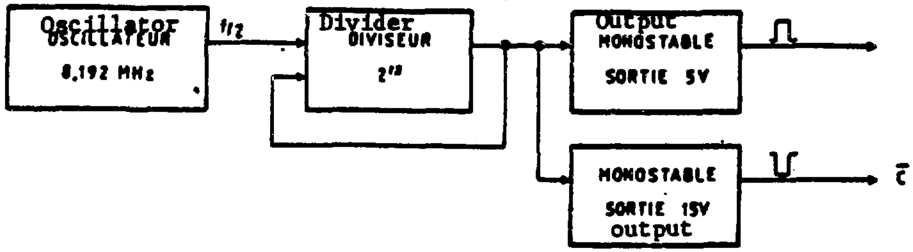
Fig. 2



Présentation de la corbeille

GENERATEURS DE REFERENCES

APPEARANCE OF THE REFERENCE GENERATOR BASKET

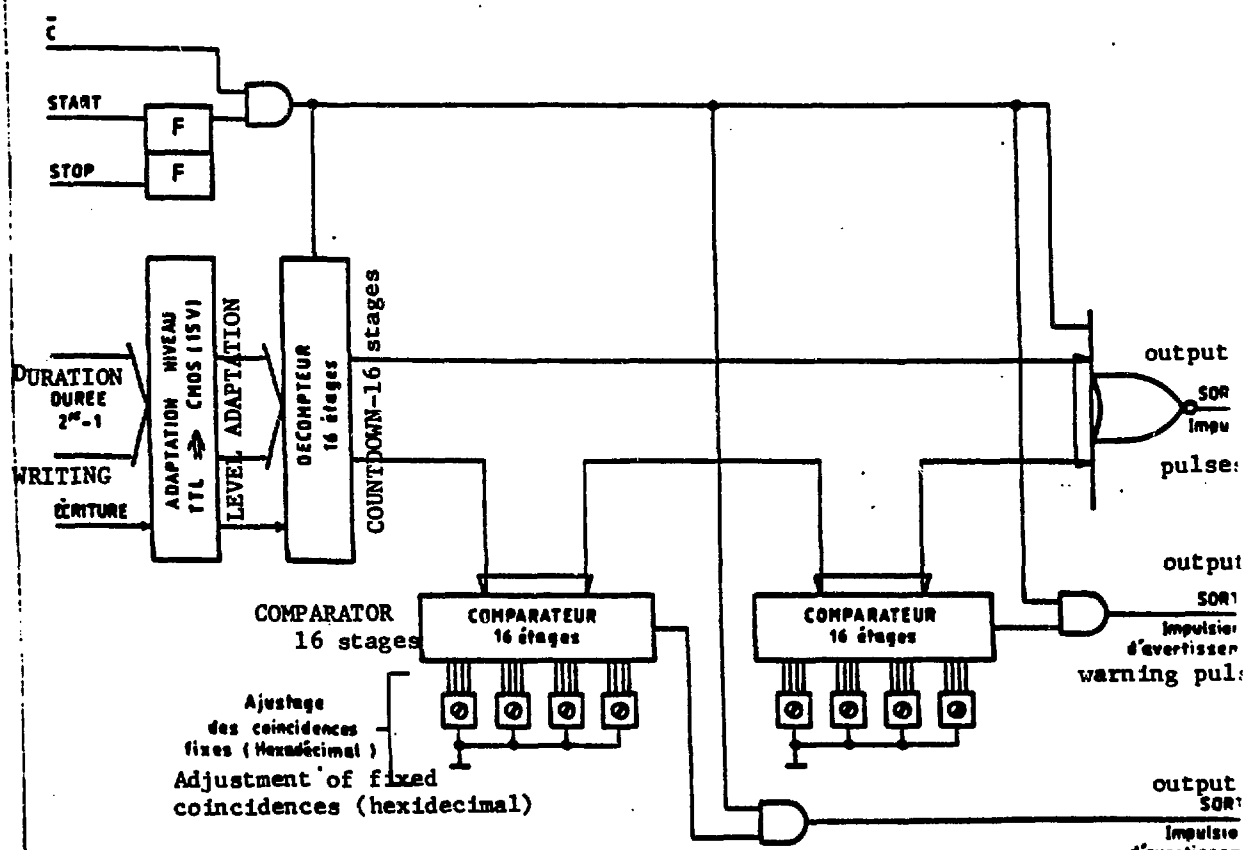


1 kHz CLOCK

HORLOGE 1KHz

Fig.4

Drawing no.
Numéro de schéma PS 125-5133 P-3-A

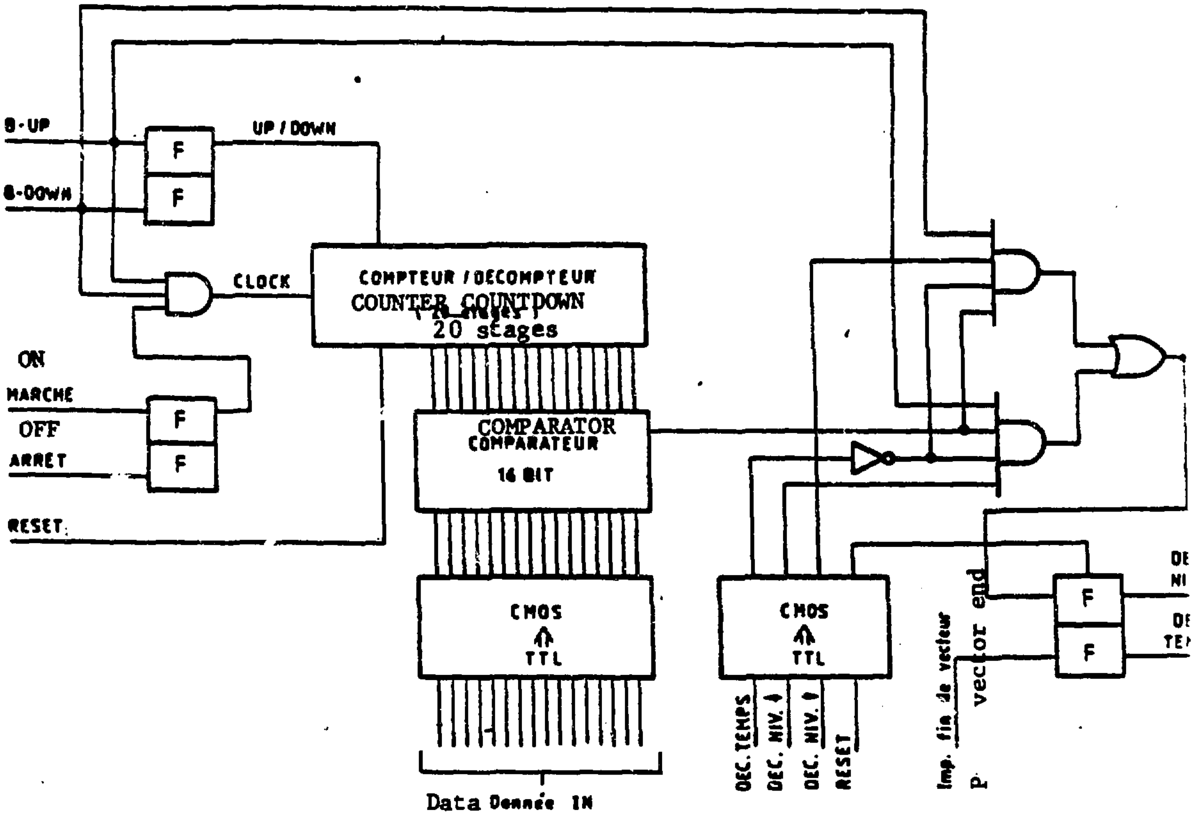


TIME UNIT

UNITE TEMPS

Fig.5

Drawing no.
Numéro de schéma PS 125-5123 P-1-F

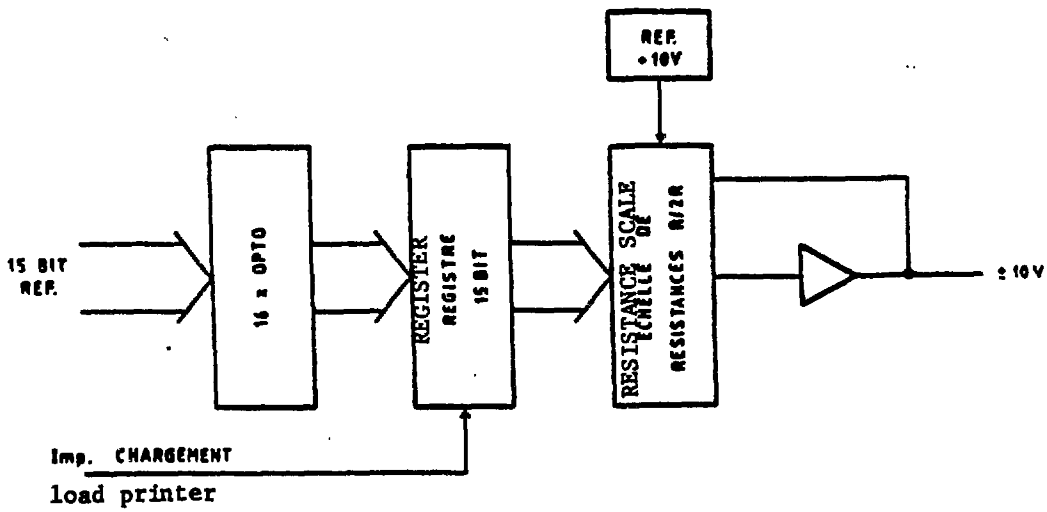


DECLENCHEMENT PAR NIVEAU B

TRIPPING BY LEVEL $\vec{B}$

Fig. 6

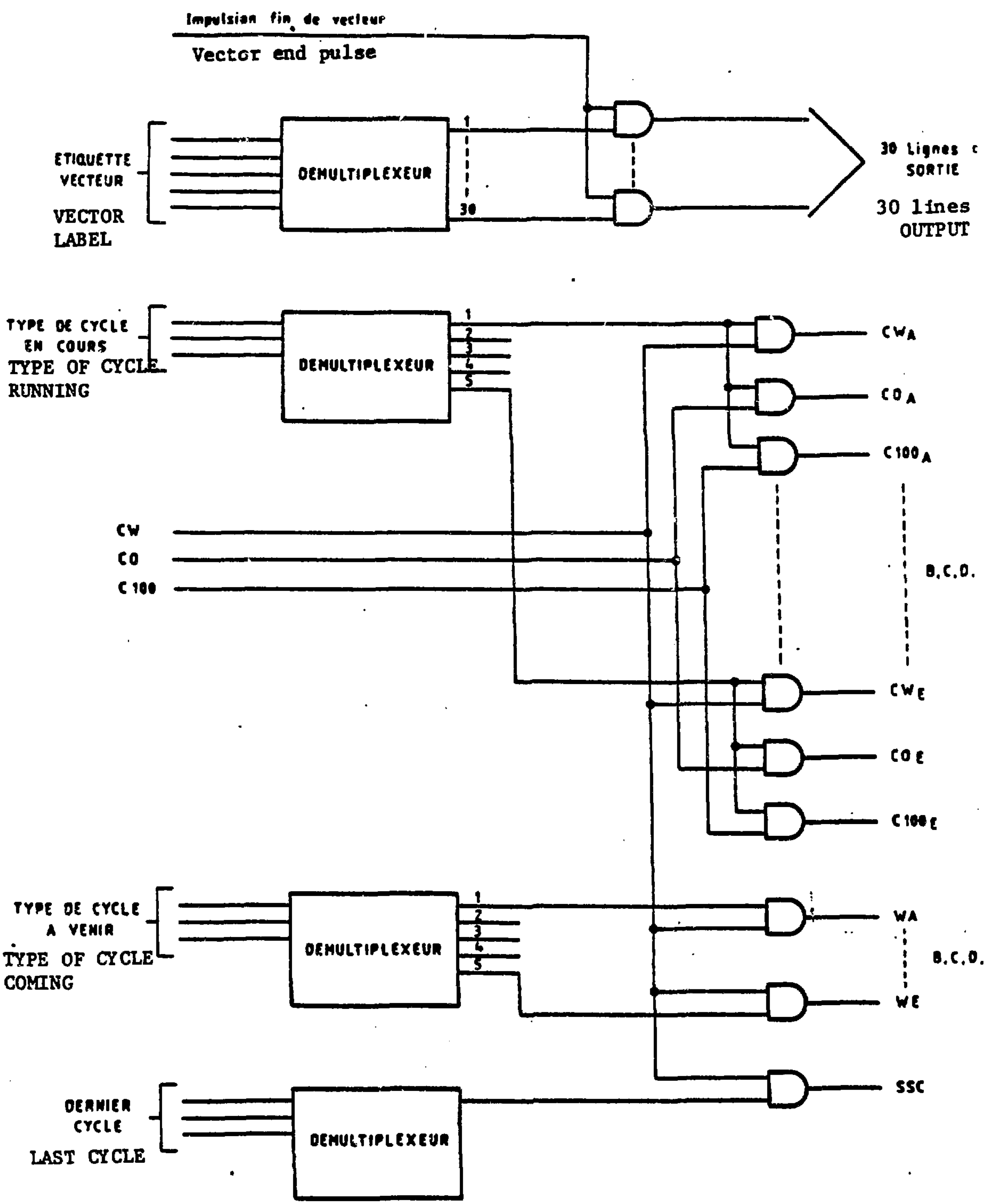
Drawing No. Numéro de schéma PS 125 - 5126 P - 2 - C



DAC 15 BIT (±10V)

Fig. 7

Drawing no. Numéro de schéma PS 125 - 5124 P - 2 - E



DECODAGE IMPULSIONS D'AVERTISSEMENT

DECODING OF WARNING PULSES

Drawing no. Fig. 8

Numéro de schéma PS 125 - 5130 P - 2 - 8

APPENDIX I
REVIEW OF CDC COMMANDS

Note: These various commands are used to communicate with the central computer CDC.

1. Select 11 on the blue box (GANDALF); do several CR to synchronize the equipment.
2. Answer questions: terminal type, LOGIN, ...
3. Call up the various service programs:

COMMAND-EDITEUR [editor]

..ATTACH SETPF

..SETPF ID = PS029COUD (identification number to call the programs written for the operation of the new pulser)

..CR (command to create a program)

100 = * Program beginning

.

.

.

1020 = END

1030 = = (double equal sign to exit program created)

..ATTACH M6800 (P6800 assembler program)

..ETL 700 (time limit)

..S, nom du ficher [file name], N (save program created in a file without line numbers)

..M6800, nom du fichier [file name] (assembly of program created)

..SCAN, LISTING (display and error search in assembled program page by page)

..L, 100,200 (display lines where an error has been located)

../Texte a corriger [text to be corrected]/ = /nouveau texte [new text]/, 150 (i.e. line 150)

..S, nom du ficher, O, N (save the new program over the old one)

..M6800, nom du ficher (new assembly)

PAS D'ERREUR [no error]

At this stage, in the file there is a program called BINOUT (to see if this file exists ..FILES). Either one wants to run this program in the simulator that is in the central computer (M68EML,ID=EP02OVONR), or one wants to load it in the development system or the equipment one has. For our part, we used the card and the monitor developed by B. Martin (DD). From the microprocessor, begin the corresponding program, that is, G1000.

MENU

1. Microprocessor to CDC dialog
2. Load CDC BINOUT to microprocessor
3. Load the hex characters to CDC
4. Return to microprocessor monitor

To enter the CDC computer from the microprocessor system, select 1, then connect line 11(as above) and do several CR to synchronize the two systems. When the program that is in the CDC computer memory is assembled without bugs, to load it into the microprocessor system, the following commands are executed:

..E, BINOUT, S

..L, A (without CR).

To return to menu, type CONTROL B

2: The transfer of BINOUT is written on the terminal. When the writing is completed, an end message gives its original address.

4: Allows testing of this program in the microprocessor.

To write a series of hex characters in the CDC computer, procede as follows: type CONTROL B, then 1 (return to CDC), then .. CR (file creation.

Again type CONTROL B, then 3: give the original addresses and the end of file.

APPENDIX II

NOTES AND DEFINITIONS ON THE ND10 ⇔ OPERATION-MICROPROCESSOR PROTOCOL

1. GENERAL REMARKS

The computer is used as a bulk storage. That means that after testing various types of cycles locally (PO), the computer will make their acquisition in order to then allow the operation to compose various supercycles.

Reading or writing cycle and supercycle tables will be done according to the corresponding protocols (see Ex1, Ex2, Ex3). Table 1 shows how the supercycle is defined and table 2 how the cycles are defined. Table 1 contains a maximum of 71 words (16 bit words), table 2, 154 (16 bit) words. The time between two readouts or write will be a minimum of 120 μs. The operation-microprocessor should be protected against write errors, so it was necessary to increase the time between the data in order to do the corresponding processing. As a consequence and in agreement with the Control group (G.P. Benincasa), the computer command will be executed in normal mode and not in DMA.

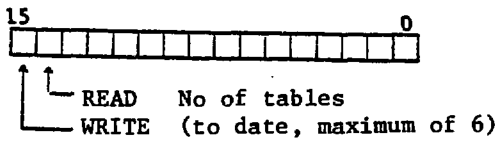
At the end of a write operation, the operation-microprocessor runs the supercycle program that it has in memory, for a visual verification of its feasibility (the simulated current of the principal power supply will be sent to the MCR); Therefore, it is indispensable to write the cycle and supercycle tables at the same time (see control word) or else to first write the cycle tables and only then the supercycle table.

When the test (supercycle feasibility) is positive and one wishes to run this supercycle on the machine, it is sufficient to send a validation command:

> VALIDATION = Transfert vers μP-machine + commande MARCHE + μP-operation à l'ecoute du μP-machine.
>
> [VALIDATION = transfer to machine microprocessor + START command +

2. DEFINITIONS

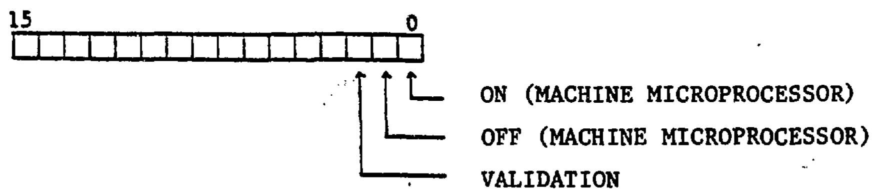
2.1. Control word



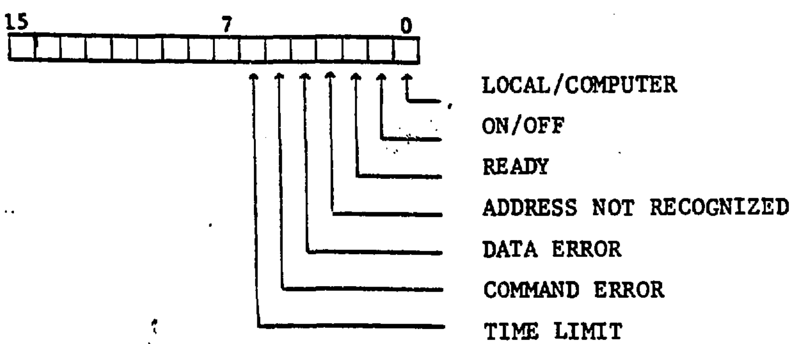
2.2. Start addresses

CYCLE A	:	0001
CYCLE B	:	0002
CYCLE C	:	0003
CYCLE D	:	0004
CYCLE E	:	0005
SUPERCYCLE	:	0006
COMMANDES	:	0007

2.3. Command word (see Ex3)

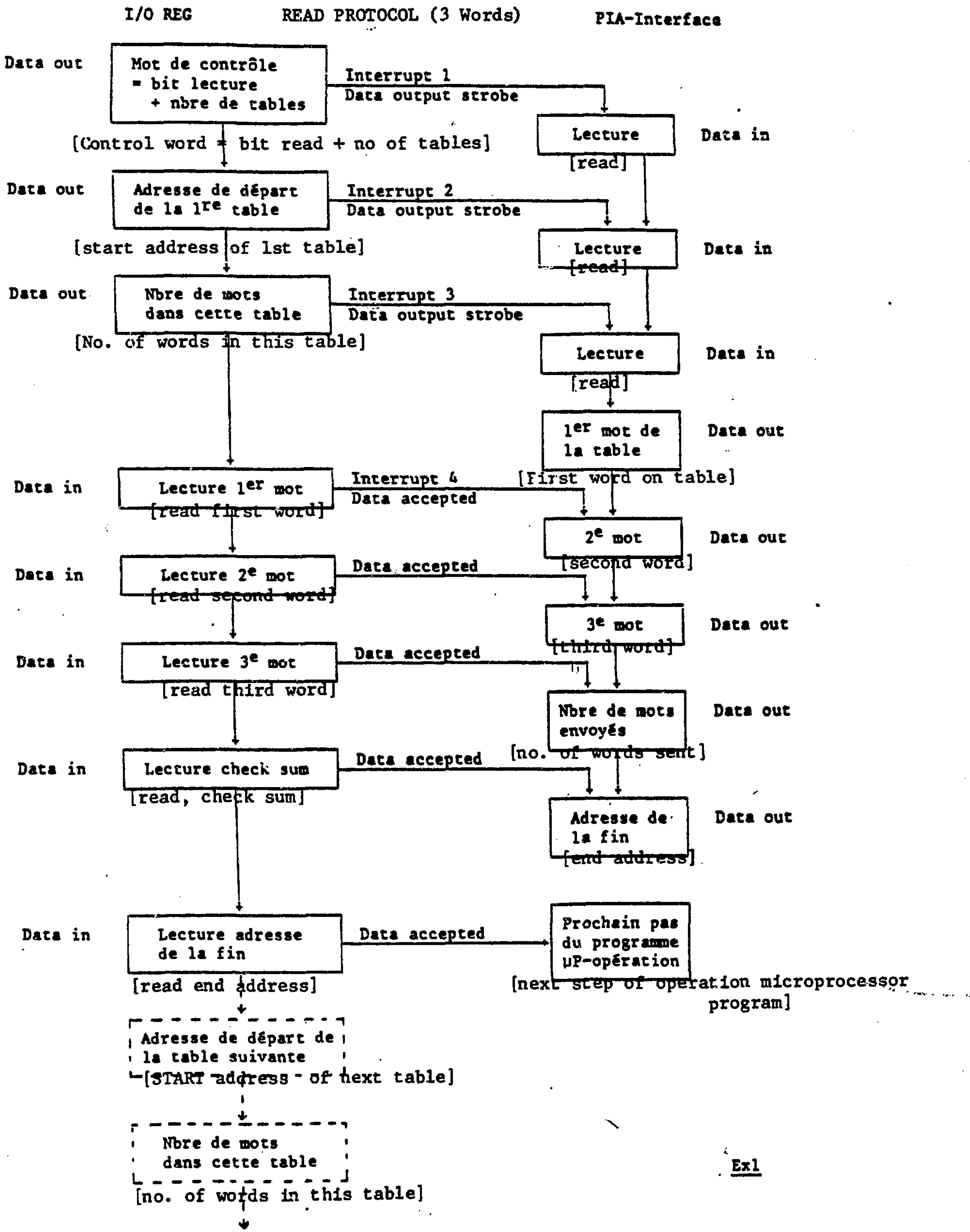


2.4. Status word for operation microprocessor at input of register 2 of I/O resigter



Note: The operation microprocessor works in positive logic where 1 corresponds to the up status.

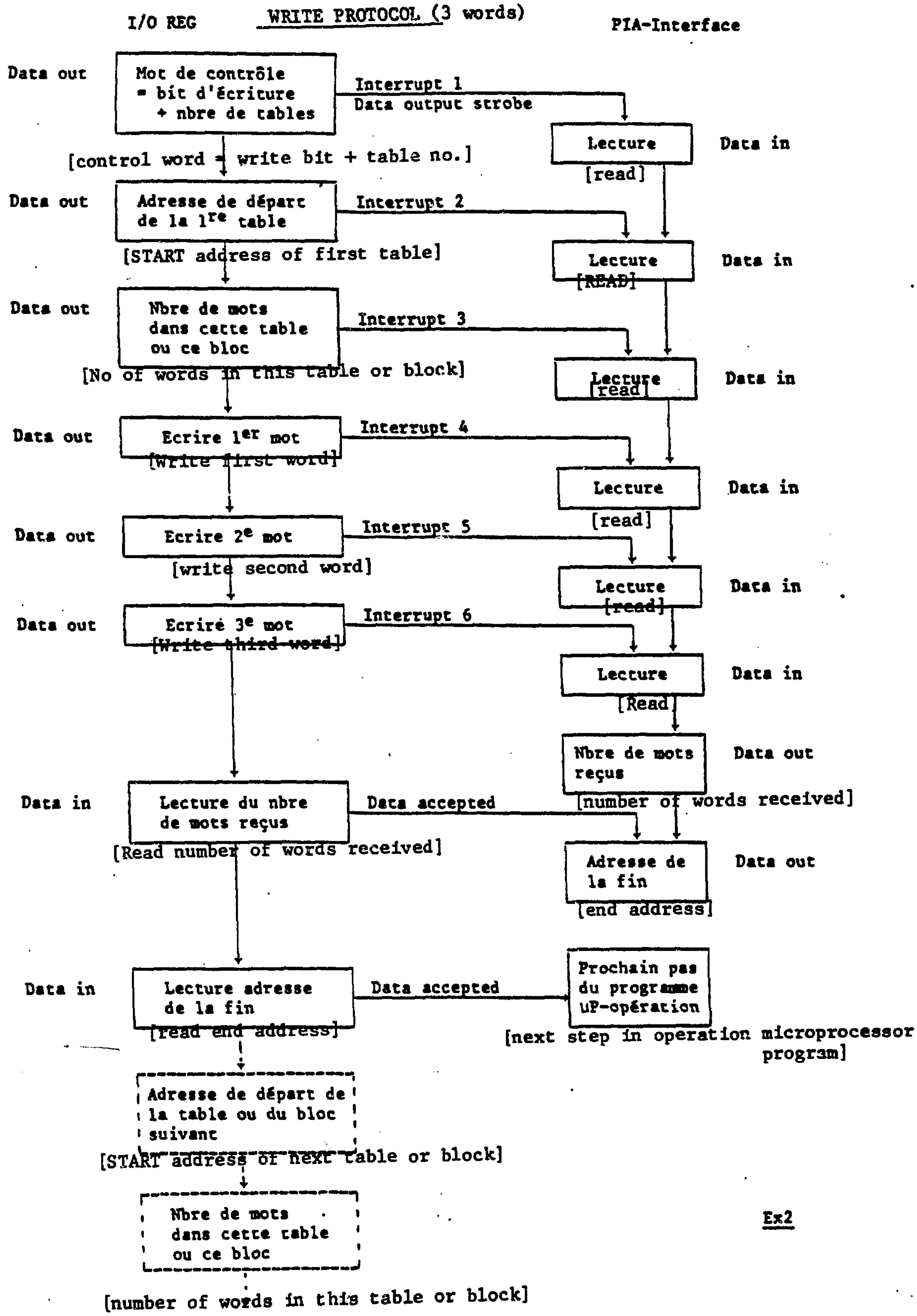
PROTOCOLE LECTURE (3 MOTS)



Exl

PROTOCOLE D'ECRITURE (3 mots)

WRITE PROTOCOL (3 words)



Ex2

PROTOCOLE COMMANDE

COMMAND PROTOCOL

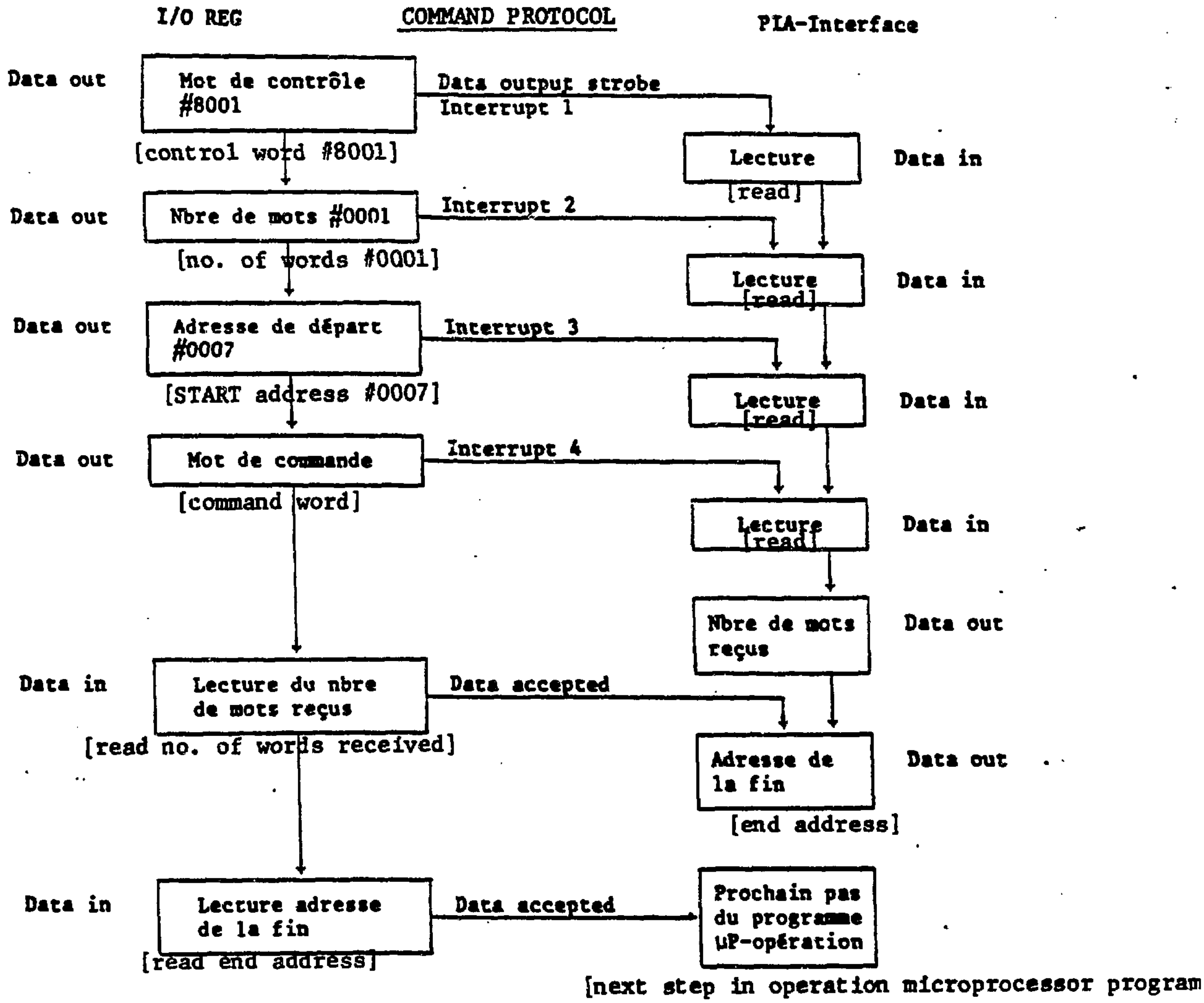


Tableau 1

TABLE I: Supercycle table Table supercycle

Paramètre Parameter	Adresse Address	Valeur Value	Remarques Remarks	
TLCPS BYTE H	#E000	≤ 65535	Taux de répétition Linac (ms)	Linac repetition rate (ms)
TLCPS BYTE L	#E001			
NBCYCLE	#E002	≤ 69	Nbre de cycles dans supercycle	No. of cycles in supe-cycle
GLISSEMENT	#E003	≤ ±109	DAC OFFSET BINARY	
CYCLE 1 BYTE H	#E004	A = 0001		
CYCLE 1 BYTE L	#E005	B = 0002		
CYCLE 2 BYTE H	#E006	C = 0003		
CYCLE 2 BYTE L	#E007	D = 0004		
CYCLE 3 BYTE H	#E008	E = 0005		
CYCLE 3 BYTE L	#E009			
⋮	⋮			

Table 2: Cycle Table **Tableau 2**

Table cycle

	Paramètre / Parameter	Valeur / Value	Remarques / Remarks	
	TYPE	01,02,03,04,05	01 ➡ A 02 ➡ B ...	
	ETIQUETTE	≤ 255	No de classement	Classification No.
	REF.P.MOYENNE	≤ ±109	DAC OFFSET BINARY	
	NOMBRE VECTEURS	≤ 30		
	COURANT I_0 BYTE H	} ≤ ±1000	DAC OFFSET BINARY	
	COURANT I_0 BYTE L			
Cycle time	DUREE CYCLE BYTE H	} ≤ 65535	MULTIPLE DE TLCPS (ms)	LCPS multiple (ms)
Cycle time	DUREE CYCLE BYTE L			
	Paramètres vecteurs [Vector parameters]			
LABEL	ETIQUETTE	≤ 30		
TRIP MODE	MODE DECLENCHEMENT	01 ➡ B-UP 02 ➡ B-DOWN 04 ➡ T	Lecture #1X ➡ NIVEAU #4X ➡ TEMPS	Read #1X LEVEL #4X TIME
Vector time	DUREE VECTEUR BYTE H	} ≤ 65535	(ms)	
Vector time	DUREE VECTEUR BYTE L			
Voltage Ref.	REF.TENSION BYTE H	} ≤ ±11000	(V)	
Voltage Ref.	REF.TENSION BYTE L			
Ramp level	NIV.RAMPE BYTE H	} ≤ ±11000	(mV)	
Ramp level	NIV.RAMPE BYTE L			
Trip level	NIV.DEC.B BYTE H	} ≤ 13000	(G)	
Trip level	NIV.DEC.B BYTE L			
LABEL	ETIQUETTE . . .			

Review **Rappel**

Cycle	Adresse de base ~~[Basic address]~~	ND10
A	#E091	0001
B	#E1D2	0002
C	#E313	0003
D	#E454	0004
E	#E595	0005

APPENDIX III

PROCEDURE FOR USE OF "SCOOTER"

L. Put the various baskets of this unit in power. At the latching in of a command program, make a MICRO-NODAL program load from the ACC floppy and send a message to the terminal: MICRO-NODAL...

2. If this message is not displayed on the terminal screen, redo initialization by pressing button Z of the SCC unit (CAMAC chassis, positions 24-25).

3. Call up the program that allows an operator to operation-microprocessor dialog by doing the command
   ❯RUN HUGOT (author of NODAL program).

Two choices are offered:

C(OMMANDES), L(ECTURE, ECRITURE) [read, write]:

-C corresponds to the commands STA(RT), STO(P) machine-microprocessor; VAL(IDATION) assures transmission of the tables from the operation-microprocessor to the machine-microprocessor and given the START command to the latter; finally, ST(ATUS) allows assuring that the operation-microprocessor scooter link is established.

-L makes it powwible to read or write in the operation-microprocessor the cycle or supercycle tables.

<u>Note:</u> A C or L command makes sense only if the operation-microprocessor allows a dialog with the scooter. Therefore, one must not forget to put the inverter of the command and status of reference and pulse generator unit on the ORDINATEUR [computer] position and validate this change (if a change has been made) by pressing the NMI operation-microprocessor button (a message *ORDINATEUR* [computer] is displayed on the LOCAL terminal).

For the various command choices, one need only answer the questions asked.

4. At the time the operation-micro and the machine-micro are turned on, do not forget that the data corresponding to the cycle and supercycle parameters previously written have disappeared. Therefore, at first one must

redefine the supercycle that one wishes to run. To do that, call the program block that allows read or write, then, after RUN HG, write L (CR).

5. Load the cycle talbe that one wants to write in the ACC

   >LOAD name of floppy file

   >DO 2

Then answer questions.

Note: After writing in the operation-microprocessor, one must be aware that it is going to want to run a supercycle automatically. But, since it [the supercycle] is not yet defined, the operation-microprocessor is going to send a message saying *DONNEES FAUTES* [data error]. This then allows the attention of the operator to be drawn to the fact that after having defined the cycles he must not forget to define the supercycle (and only in that order).

6. To have this supercycle that has just been defined run by the machine-microprocessor, recall the program C(OMMANDES).
   Write VAL(IDATION): Automatically, the cycle and supercycle tables are written in the machine-microprocessor and a START command is given to it. The operation-microprocessor is also automatically "launched" in a program of reading the trip mode of the vectors.

7. To read a cycle or supercycle table, the L(ECTURE) [read] program must be called up again and its questions answered.
   The table received by the scooter is unfortunately not interpretable at first glance, since it is written in hexadecimal. This is not only a problem, since it could be diagnosed as to where a transcription error exists. In addition, one must be aware that there is an interpretation program at hand that allows display of the entire table read depending on the definitions of the various tables.
   In order to interpret a table that is on a floppy but which one does not want to write, the table most be loaded into the ACC.

   >LOAD name of file

   and then >DO 40

8. To save a program that has just been written on a floppy, procede as follows:

   ❯CRFIL (name of file, 1): Creation of a 1-page file (1 kwords minimum)

   ❯SAVE name of file TAB: This TAB corresponds to tables of data that are to be saved. In our application, therefore, the table that is in the operation-microprocessor must first be read then saved.

Note: The file name does not necessarily have to be related to the type of cycle, because when this table is written in the operation-microprocessor and only then, it is sufficient to define in what table one wishes to load this data: the addressing and the code number will be defined prior to execution of a writing.

9. To read all of the files on the floppy

   ❯LISF

10. To erase a file from a floppy

   ❯DLFIL

Be careful! in this case the entire file is destroyed, which means the data contained and also the space reserved.