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LPI FAST TIMING SEQUENCER (IKBOX)

AND

DATATABLE EDITOR

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Abstract

Description of the Fast Timing Sequencer for the LEP PreInjector. The LPI Fast Timing Sequencer permits to control the operational states of the LPI with a resolution of 10 ms by modulating the LPI Timing system.
Included in this paper is also the special purpose local editor to fill the Datatables.

Geneva Switzerland

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1 INTRODUCTION

This note describes the LPI Fast Timing Sequencer (IKBOX) and the associated Datatable Editor. This description is very general and is intended as the Users Manual for the programming of the LPI Fast Timing Sequencer by the Operations and the Machinespecialists. More technical details can be found in the LEP Preinjector 19 MHz Fast Timing System Technical Reference Manual.

2 DESCRIPTION OF THE LPI FAST TIMING SEQUENCER (IKBOX)

2.1 General

A typical operational supercycle looks like in fig 1 :LPI Supercycle. It is composed out of 1 e^+ accumulation + 2 e^+ ejections and 2 e^- accumulations + 2 e^- ejections. A LPI cycle is defined as the time between 2 consecutive ejections , so the supercycle is composed out of 4 cycles that are not necessarily all of equal length. It is not mandatory that a cycle contains an accumulation e.g.: the second e^+ cycle contains no accumulation. As is standard in the PS controls system the LPI is controlled by a PLS which is especially generated for LPI. This LPI-PLS is broadcasted every 1.2 seconds which corresponds to a Basic Period . This means that several consecutive LPI-PLS telegrams can be emmitted during an LPI cycle (e.g. e^+ cycle).

For the LPI-19MHz timing system this Basic Period is the basic building block in time. The LPI-PLS determines what the LPI-19 MHz timing will do the next 1.2 s. The LPI on the contrary has an internal pulse frequency of 100 Hz which means that some refinement is necessary for the LPI-PLS. This refinement is realized by the LPI Fast Timing Sequencer (also called the IK-box) as proposed by the LPI machine specialists. Basicaly it is build from a standard SMACC in a CAMAC crate with a special purpose program in it.

2.2 Functional description in the LPI timing system

The required resolution and stability of the LPI timing system has to be at least 1 ns. Because these requirements are not standard in the PS controls system special techniques have to be used, especially the 1 ns resolution which is given by mechanically switched cables. In the standard PS control system the timings are conditioned by reloading the CAMAC counters in a PPM mode. In the LPI timing system this method is not possible because of hardware constraints. The counters and the delay lines would have to be reloaded as fast as every 5 ms. Therefore a system was proposed in which all the possible timings are generated at all times in parallel and the selection of the used timing pulses is made only in the last stage of the timing system (fig 2 : TIMING SELECTION).

The generation of the beam is synchronized with the zerocrossings of the 50 Hz mains which gives a beam pulse frequency of 100 Hz (10 ms)(PRODUCTION STATE). Another constraint for the specific equipment is that even if a particular equipment is not used during a LIL period it has to be pulsed anyway to keep its temperature equilibrum e.g.: during e^- production LINAC V has to be pulsed while it is not used for beam production. To avoid interference on the beam these equipments will then be pulsed while there is no beam in the machine, in most cases on the tops of the 50 Hz or 5 ms shifted compared to the zerocrossings (DUMMY STATE). For some particular equipments the shift is only 1 ms (e.g. the guns).

As can be seen in fig 3 :IKBOX TIMING DIAGRAM ,a PRODUCTION/DUMMY (P/D) train is distributed which gives the condition whether or not a beam is allowed to be produced. When this signal line is 1(TTLbar = 0V) = PRODUCTION, the beam is allowed to be produced and accelerated.

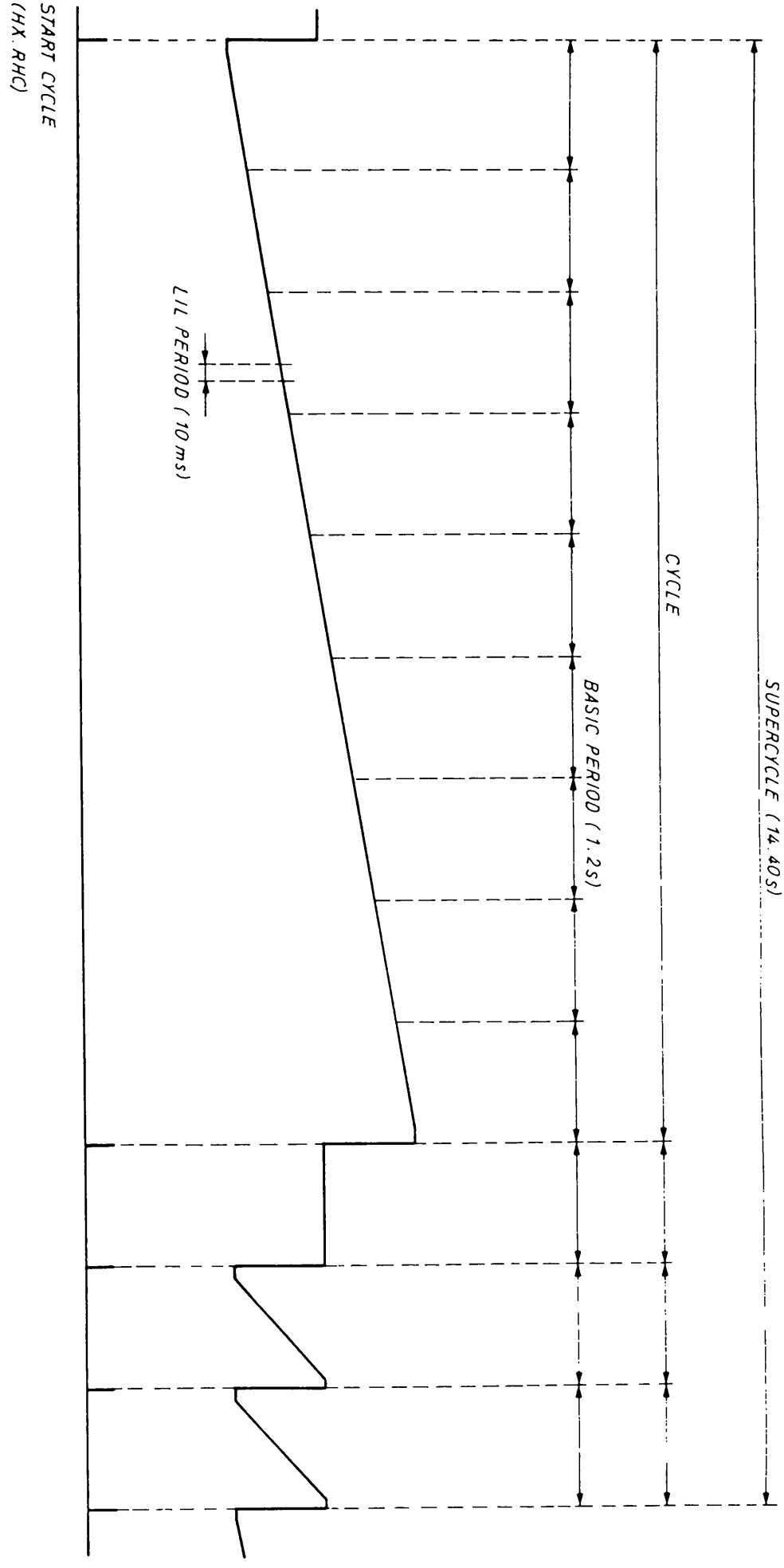

Fig. 1 : LPI SUPER CYCLE

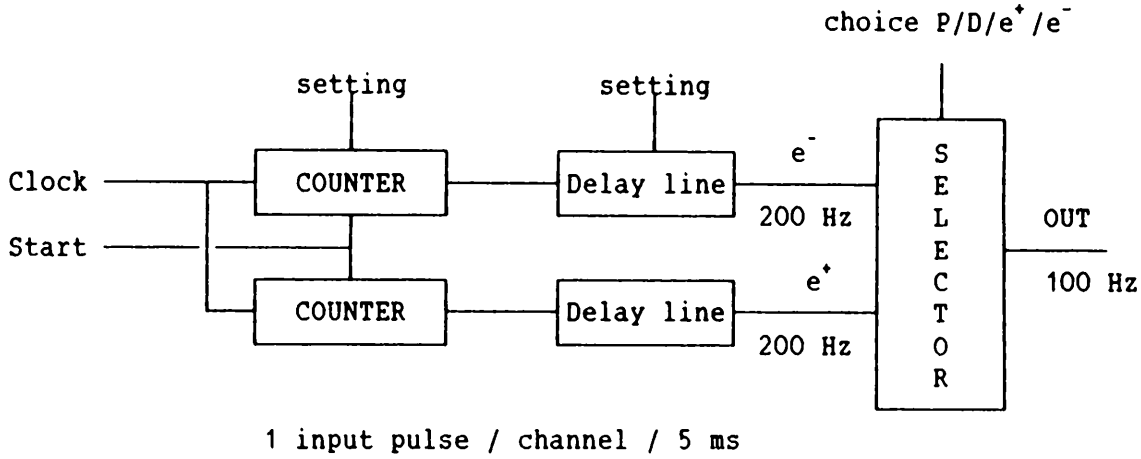

FIG 2 : TIMING SELECTION

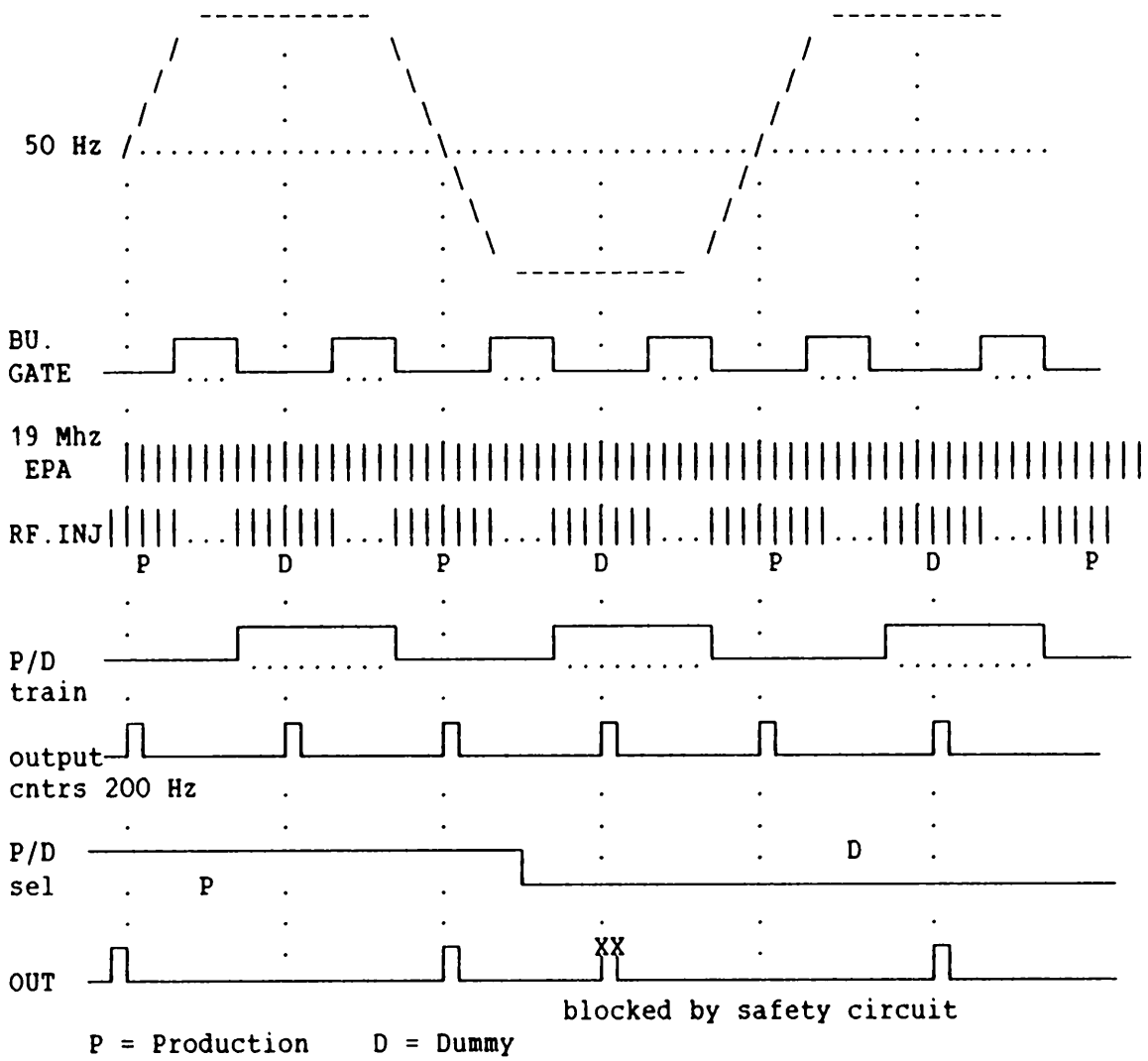

FIG 3 : IKBOX TIMING DIAGRAM

When this line is 0(TTLbar=+5V) = DUMMY,then a beam is not allowed to be produced nor accelerated. During normal operation of the LPI, the counters will produce an output pulse every 5 ms (200 Hz), one during the period the P/D line is high and one during the P/D line is low. By means of logic gates one can program now which of the output pulses will be transmitted to the equipment. If one programs the timing pulse generated during the Production period, the equipment will pulse in the Production state and will produce or accelerate the beam, and the timing pulse during the Dummy state will be blocked. The opposite is true if one programs the Dummy pulse as the true pulse. Another constraint for the specific equipment is that it is not allowed to be pulsed with a time interval smaller than 10 ms. This means that if a switchover is made from Production to Dummy state or viceversa the minimum delay between two consecutive pulses will be at least 15 ms. In the selector a security is foreseen so that a pulse coming less than 8 ms after the precedent pulse is blocked (fig : 3). If one wants a timing that is slightly different for the two kinds of particles for example, it is impossible with this hardware configuration to reload the counters and delay lines in a LIL pulse to pulse mode. Therefore two complete separate lines are foreseen and in the last stage of the timing system the correct selection is made by means of logic gates. The selector module has to select one out of four input pulses of which two can come shifted in time on each of the two input lines(fig 4: SELECTOR/LINEDRIVER). The selector also incorporates the line driver (blocking level).

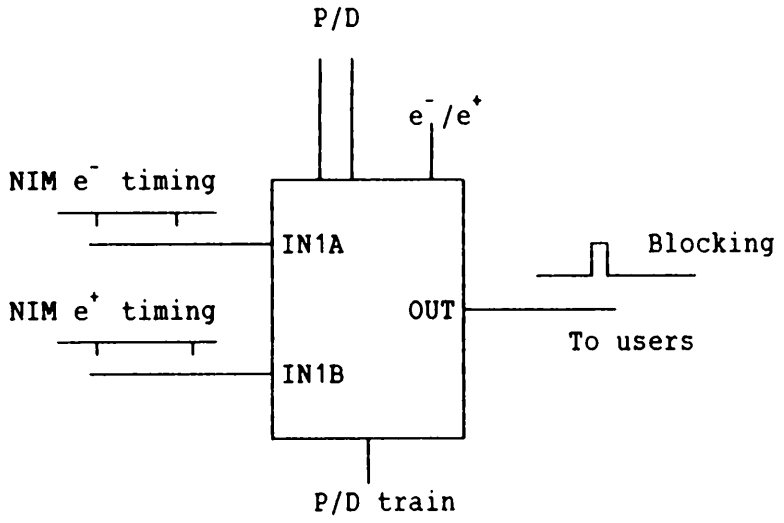

FIG 4 : SELECTOR/LINEDRIVER

Changes from Production to Dummy state can happen as fast as in 10 ms. The LPI-PLS has a resolution of only 1.2 s, therefore some kind of refinement is necessary.

The solution to this problem is as proposed by the LPI machine specialists, a programmable device that can give out the state of every equipment during the next 10 ms. The location of this device in the LPI timing system is shown in fig 5 :General layout of the 19MHz fast timing system.

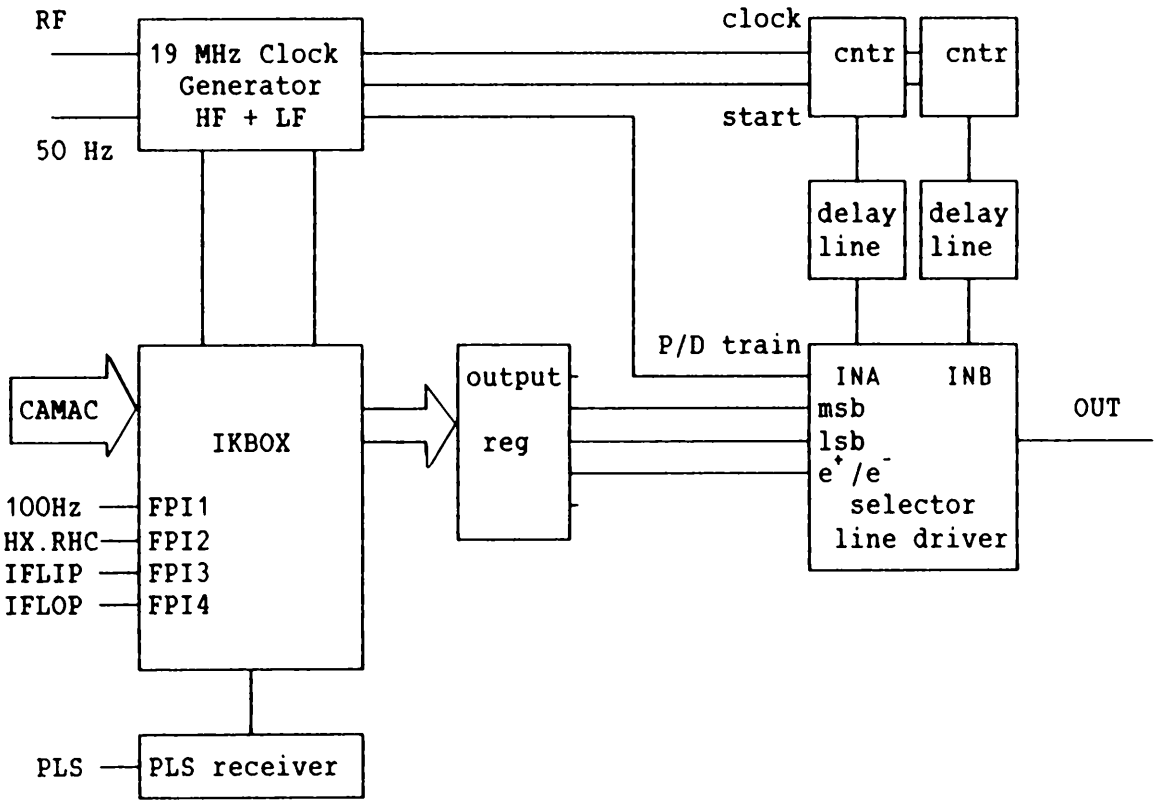

FIG 5 :GENERAL LAYOUT OF LPI 19 MHZ FAST TIMING SYSTEM

2.3 Functional description of the IKBOX

The IKBOX is a programmable device in which certain tables can be modified by the Operation. The IKBOX contains 3 different kinds of tables (fig 6 :IKBOX Table organisation) :

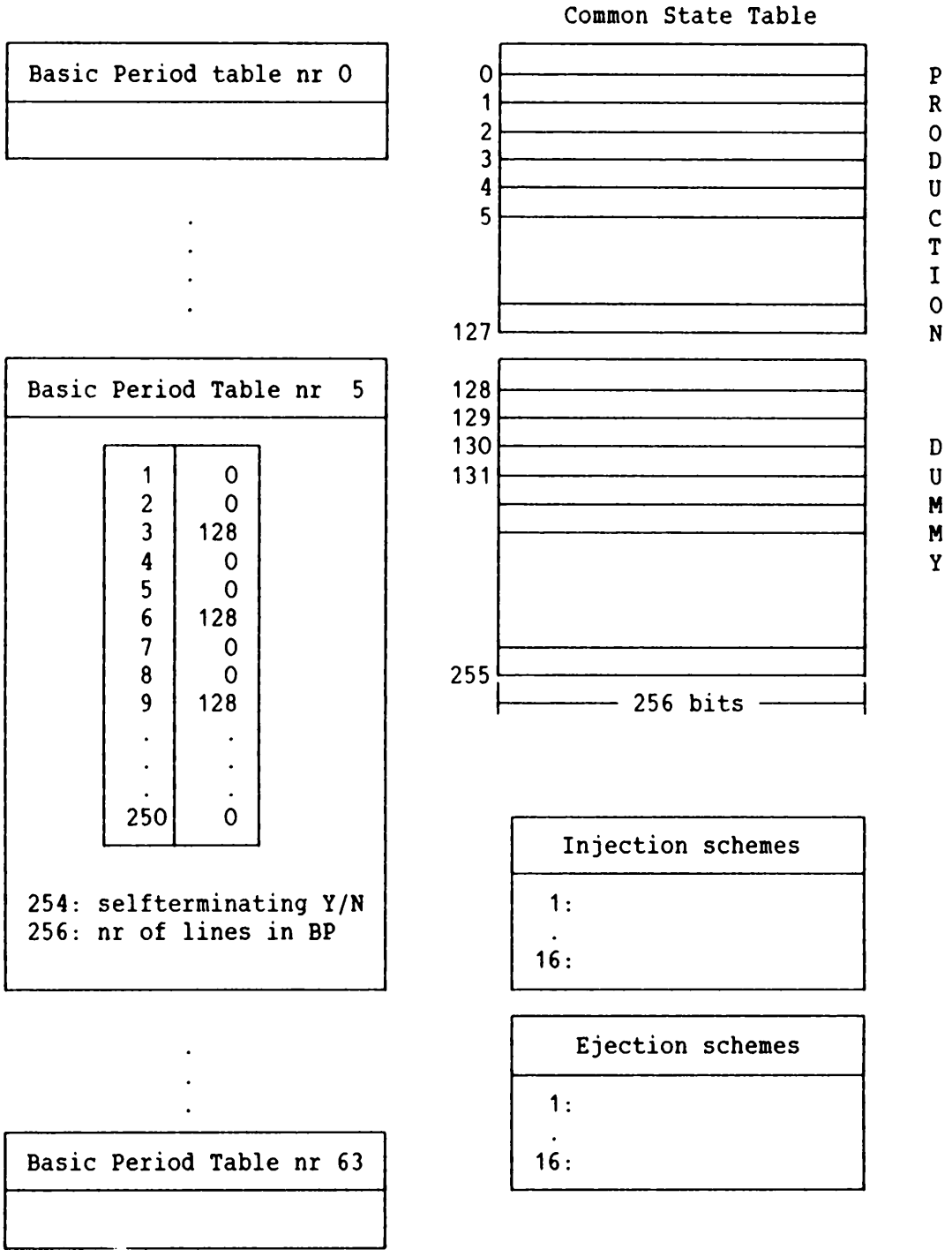

FIG 6 : IKBOX TABLE ORGANISATION

2.3.1 Common state tables

This is a table of 256 bits wide and 256 lines deep. The 256 bits are divided in groups of 4 and every group will command the timing of a particular equipment e.g. :MDK25. In each group bits 2 and 3 determine whether the equipment is pulsed in PRODUCTION or DUMMY or not pulsed at all. The 4rd bit(LSB) determines whether timing channel 1 or 2 is used e.g.: e^+ or e^- . The 1rst bit(MSB) is a spare bit. So a line of 256 bits can determine a maximum of 64 equipments. A certain amount of the bits will be used for special applications. The block of 256 lines is divided in 2 parts. The first 128 lines (0-127) are considered as PRODUCTION lines, the last 128 lines (128-255) are considered as DUMMY lines. These 256 lines are used as a reference library for the basic period tables. A list of all the timings controlled by the LPI Fast Timing Sequencer is shown in fig 8.

2.3.2 Basic period tables

This are 64 lists of pointers to the Common State table(fig 7 :IKBOX general layout). Every pointer in a Basic Period will point to a line in the Common State table. This line is fetched synchronised with the 100 Hz interrupts and will determine the state of the timing system during the next 10 ms (the next LIL shot). On every 100 Hz interrupt the next pointer in the Basic Period is taken. Every table is programmed for a certain number of pointers, in most cases 120. Space for a maximum of 250 pointers is foreseen per Basic Period table(e.g. LPI Basic Periods of 2.4 s). The number of LIL periods in every Basic Period is indicated in each Basic Period Table.

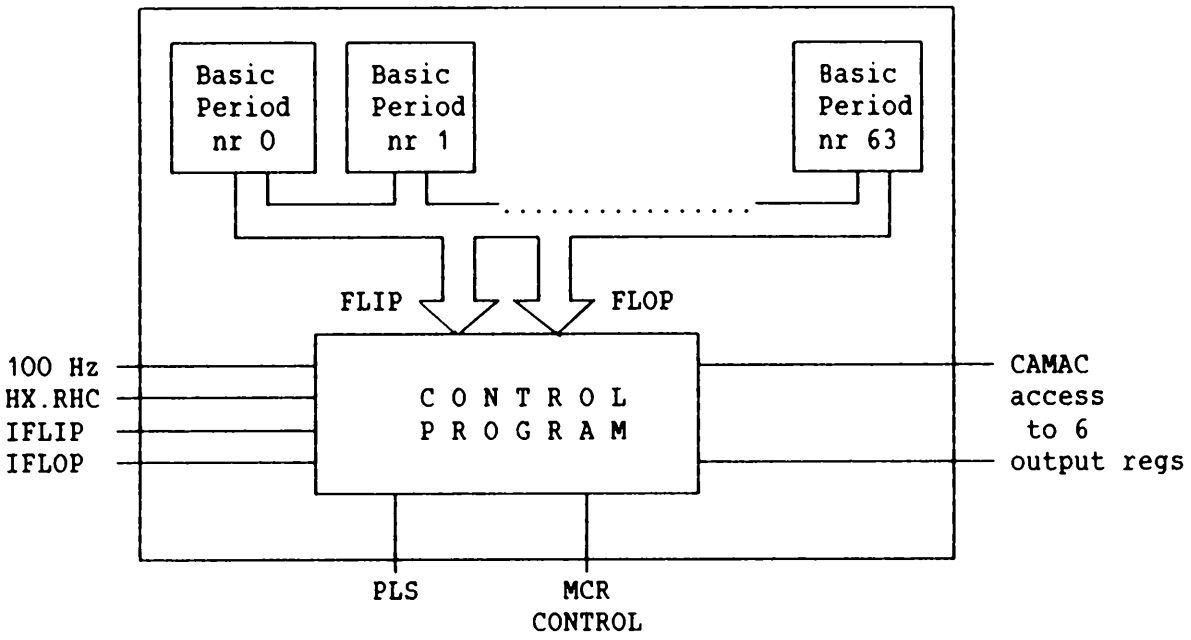

FIG 7 : IKBOX GENERAL LAYOUT

FIG 8 : TIMINGS CONTROLLED BY THE LPI FAST TIMING SEQUENCER

P : Production
+ : Production e^+
- : Production e^-

D : Dummy
I : Inhibit

Equipment	Names of Timing pulses conditioned by the LPI Fast timing sequencer				Possibilities P	+	-	D	I
BKLY	VX.SBKLY								
GUN V	VX.WGUNP	VX.SGUN	VX.TAS		X			X	
MDK 03	VX.SKLY03	VX.SRFP03	VX.ERFP03		X			X	
MDK 13	VX.SKLY13	VX.SRFP13	VX.ERFP13	VX.SRFI13	X			X	
CONV	WX.FCEP	WX.WCEP	WX.SCEP			X	X		
GUN W	WX.SGUN	WX.WGUNP	WX.TAS		X			X	
MDK 25	WX.SKLY25	WX.SRFP25	WX.ERFP25		X			X	
MDK 27	WX.SKLY27	WX.SRFP27	WX.ERFP27	WX.SRFI27		X	X	X	
MDK 31	WX.SKLY31	WX.SRFP31	WX.ERFP31	WX.SRFI31		X	X	X	
MDK 35	WX.SKLY35	WX.SRFP35	WX.ERFP35		X			X	
KFI 11	HX.WKFI11	HX.SKFI11	HX.EKFI11		X			X	X
KFI 31	HX.WKFI31	HX.SKFI31	HX.EKFI31		X			X	X
KFI 71	HX.WKFI71	HX.SKFI71	HX.EKFI71		X			X	X
KFI 91	HX.WKFI91	HX.SKFI91	HX.EKFI91		X			X	X
KFE 49	HX.WKFE49A HX.SKFE49A1 HX.SKFE49B1	HX.WKFE49B HX.SKFE49A2 HX.SKFE49B2	 HX.SKFE49A3 HX.SKFE49B3	 HX.SKFE49A4 HX.SKFE49B4	X				X
KFE 51	HX.WKFE51A HX.SKFE51A1 HX.SKFE51B1	HX.WKFE51B HX.SKFE51A2 HX.SKFE51B2	 HX.SKFE51A3 HX.SKFE51B3	 HX.SKFE51A4 HX.SKFE51B4		X	X		X
SMH 00	HX.SSMH	HX.SKFE			X				X
ACCUM	HX.RAC	HX.RSTO			X			X	
PROD GUN	HX.TPG	HX.AS				X	X		

2.3.3 Injection and ejection scheme tables

Every injection or ejection table is a list of bucket numbers. They give the order in which the buckets in EPA have to be filled or ejected. Place for 16 injection and 16 ejection schemes is foreseen.

On every LPI-PLS telegram, generated by the TSU, the IKBOX reads the contents of the telegram. The telegram contains the injection and ejection type and 2 Basic Period numbers, the FLIP and FLOP Basic Period number

The FLIP and FLOP Basic Period mechanism is foreseen to allow rapid changes in the cycle controlled by external conditions. The external conditions acting on the LPI-PLS allow only changes with a resolution of 1.2 s. In certain cases a much finer resolution is required e.g. :the control of the intensity of the beam in EPA. To accomplish this requirement the following solution is foreseen. One programs 2 different Basic Periods Tables for every cycle: the FLIP and the FLOP Basic Period. Also 2 external interrupts are foreseen:

1) IFLOP forces a switchover to the FLOP Basic Period Table and 2) IFLIP forces a switchover to the FLIP Basic Period Table. This switchover is synchronised on the next 100 Hz interrupt. On every start of a cycle the IKBOX will always start executing the FLIP Basic Period Table. An example of the mechanism is given in fig 9 : FLIP-FLOP mechanism : intermitted accumulation of e^{+} in EPA. If just before the interrupt the IKBOX was executing line 50 of one Basic Period Table, after the interrupt the IKBOX will fetch line 51 of the other Basic Period Table.

On every 100 Hz interrupt the next line in the Basic Period Table is executed and only if the executed line is a PRODUCTION line (0-127) the injection scheme counter is incremented. If the executed line is a DUMMY line (128-255) the counter is not incremented. The injection scheme counter is only reset on a start cycle. In normal cases the injection sheme will not change during a cycle. The IKBOX will send the correct bucket numbers for injection and ejection to the 19 MHz clock generator HF(in the same crate) for the bucket synchronisation of the clockbursts to all the counters.

2.4 Software in the IKBOX

To accomplish the specifications stated above there have to be 5 asynchronous tasks in the IKBOX:

1)100 Hz μP Int : gives the beginning of the 2 ms window in which the IKBOX is allowed to change the state of the LPI for the next LIL period.

2) START CYCLE : gives the exact moment when to use the new Basic Periods requested by the LPI-PLS.

3)IFLOP : gives the moment the IKBOX has to switch to the FLOP Basic Period.

4)IFLIP : gives the moment the IKBOX has to switch to the FLIP Basic Period.

5)PLS RECEIVER LAM: the LPI-PLS has arrived and can be read.

Task 5 will be common to all SMACC's in the system and will be written by the PLS specialist.

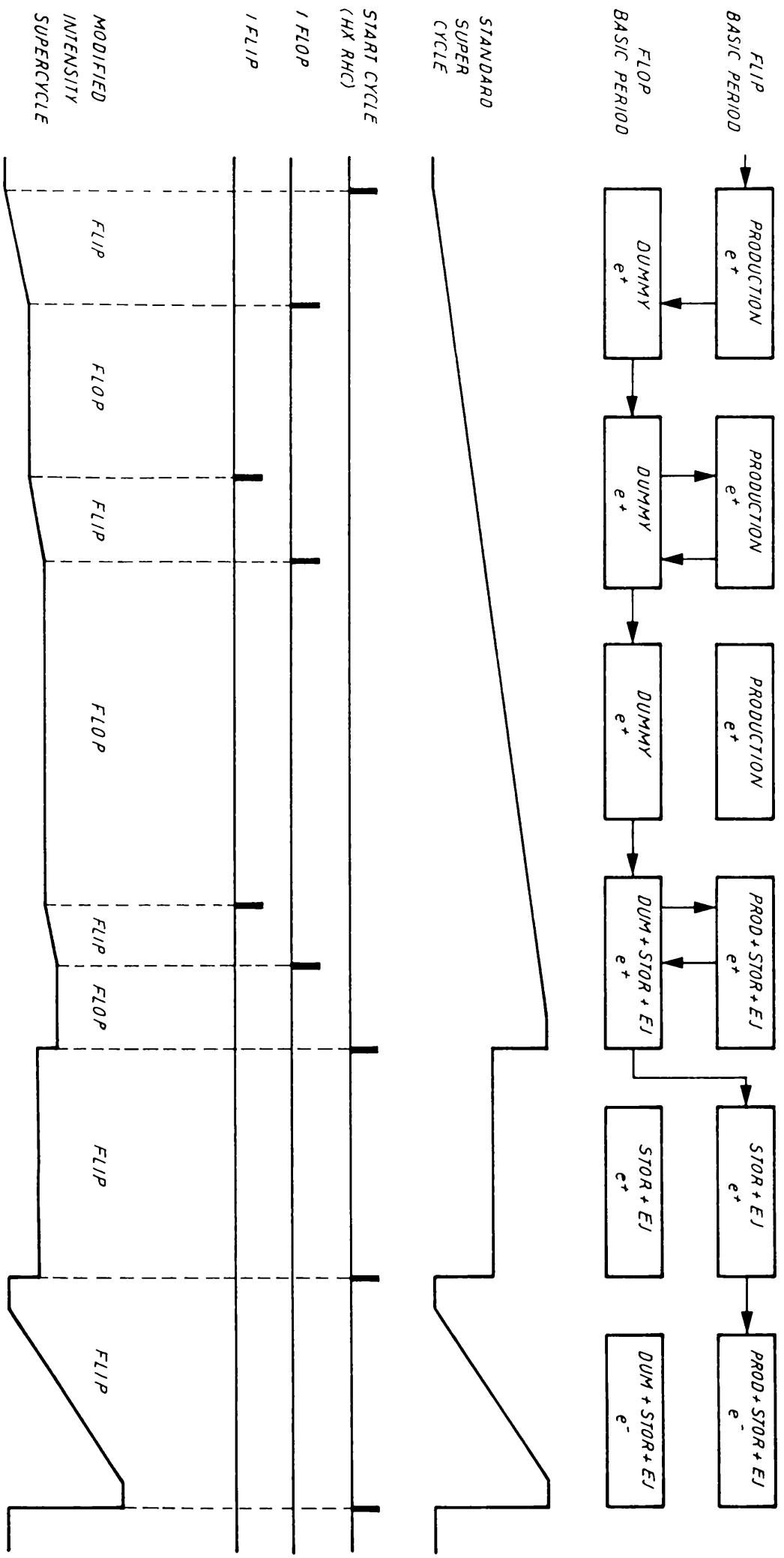

Fig. 9 : FLIP-FLOP MECANISM

Except for the operating system there is no main task in the SMACC. In fact there are 5 independent tasks that are started by an interrupt. A problem is that the interrupts come completely asynchronous. In the worst case the interrupts 1,2 and 3 can come at the same time and have all to be processed within 2 ms.

In order to stay within the PS/CO standard a standard SMACC with RMS68K is used. The routines are written in assembler M68000.

2.5 Special cases

2.5.1 ON-OFF of the bumper magnets in EPA

Because the use of the bumper magnets on the beam causes a certain loss on the stored beam in EPA one wants to use these bumpers only when there is really injection into or ejection from EPA. When no beam is produced for a certain time the bumper magnets have to be inhibited. The solution to the problem is given in PS/CO/WP 85-060 : Specification du timing pour les bumpers de EPA / P. Burla. In total 2 special purpose timing pulses are needed : start accumulation (HX.RAC) ,stop accumulation (HX.RSTO). These pulses are generated directly by the IKBOX and associated output registers. 2 Outputs of an output register are connected to a TTL/hi level converter in order to produce 2 Blocking pulses. These pulses are produced in the 2 ms charging window of the IKBOX which is from 8 to 6 ms before the first production pulse so the bumpers are settled before the first possible injection.

2.5.2 Gun Production train

For the instrumentation a train is required which gives only pulses when really beam is produced in the Linacs. The beam/no beam situation is only determined by the status of the 2 Guns. So there are 2 beam trains ,one for GUN V and one for GUN W. These 2 have to be multiplexed depending which Gun is used at that moment. At the Start cycle the IKBOX will chose, depending on the particle type, one of the 2 beam trains by addressing a selector which has as input on channel 1A the Production GUN V train and on channel 1B the Production GUN W train. The output will be the correct Production Gun train (HX.TPG). The train HX.TPG is located approximately at - 2μs relative to the beam. A second similar train HX.AS is produced as a common measurement trigger for all the other equipments e.g. Converter, injection kickers, etc. The train HX.AS is a copy of the train HX.TPG except that HX.AS is located at -1 ms relative to the passage of the beam.

2.5.3 Booster klystron

The Booster klystron has to pulse at a constant frequency of 200 Hz. On the selector the P/D train is replaced by a constant PRODUCTION input and the IKBOX has to program the selector constantly in PRODUCTION. Control by the IKBOX over this selector is only usefull to have the possibility to block the output. This 200 Hz frequency has also as consequence that for the selector the 8 ms security has to be inhibited. This forces us to implement switches inside the module.

3 DESCRIPTION OF THE McINTOSH NODAL EDITOR FOR THE DATATABLES

3.1 General

The "IKBOX-EDITOR" is a McNodal program that runs on a McIntosh microcomputer. The purpose of this program is to fill the datatables for the IKBOX, mainly the Common State Tables and the Basic Period Tables. The program also permits to make a complete simulation listing of a Basic Period. The edited data are stored on a file on the McIntosh diskette. This file can be downloaded by the REMOTE COMPUTER feature on the McIntosh. This way one has to run the NODAL program "DOWN" in the SMACC. This program takes the datafile from the diskette and copies it to the memory in the SMACC via the serial port on the SMACC. This program will put the IKBOX in the DUMMY state during the transfer of the data to avoid problems the moment the datatables are overwritten. Each program will be explained further in the following paragraphs.

3.2 IKBOX-EDITOR

After startup the McIntosh is automatically in the McNodal mode . To run the editor one has to type after the NODAL prompt (>) "RU IKBOX-EDITOR". The program is build up in the form of menus which propose the user a choice of what to do. The user has to respond with a number. The first menu asks what to do :

1) edit or display tables
2) simulation listing

In most cases the option 1 (edit) will be chosen.
The next question is "Give source filename" where to get the data to act upon. One has to type the the filename e.g. : "DATA". If one wants to start from scratch an empty file exists called "EMPTY". The chosen file is now fetched from disk.
The next question asks what to edit:

1) Common State Table
2) Basic Period Table
3) Injection scheme Table
4) Ejection scheme Table
5) Editing finished and ready to restore

Only option 1) and 2) give the user the opportunity to edit tables. Option 3) and 4) give only the choice to list the fixed tables on the screen or on the printer. Because the injection and ejection schemes are considered as fixed, the user does not have to create these for every version of the datatables in the IKBOX. If one really wants to change or add these data, one has to add these in the NODAL program itself in the block 49 for the injection schemes and in block 50 for the ejection schemes. For option 1) and 2) the editor will guide the user further down into the tree with new menus. The

editor allows the user to create new lines or tables, copy them and/or modify them.

Option 1) through 4) give also the possibility to list the result on the screen or the printer connected to the McIntosh.

A few examples of printouts are showed in fig 10 : COMMON STATE TABLE LISTING, fig 11 : BASIC PERIOD TABLE 4 , fig 12 : BASIC PERIOD TABLE 5 and fig 13 : INJECTION SCHEME LISTING.

FIG 10 : COMMON STATE TABLE LISTING

COMMON STATE TABLE

```
.....................................................................
 L . B. G. K. K. C. G. K. K. K. K. K. K. K. K. K. S. A. G.  .
 I . K. U. L. L. O. U. L. L. L. L. F. F. F. F. F. M. C. U.  .
 N . L. N. Y. Y. N. N. Y. Y. Y. Y. I. I. I. I. E. E. H. C. N.  .
 E . Y. V. 0. 1. V. W. 2. 2. 3. 3. 1. 3. 7. 9. 4. 5. 0. U. P.  .
 N .  .  . 3. 3.  .  . 5. 7. 1. 5. 1. 1. 1. 1. 9. 1. 0. M. R.  .
 R .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  . 0.  .
   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  . D.  .
.....................................................................
  0) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.
  1) X. D. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.
  2) X. P. D. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.
  3) X. P. P. D. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.
  4) X. P. P. P. D. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.
  5) X. P. P. P. P. D. P. +. +. P. P. P. P. P. +. +. P. P. +. X.
  6) X. P. P. P. P. P. D. +. +. P. P. P. P. P. +. +. P. P. +. X.
  7) X. P. P. P. P. P. P. D. +. P. P. P. P. P. +. +. P. P. +. X.
  8) X. P. P. P. P. P. P. +. D. P. P. P. P. P. +. +. P. P. +. X.
  9) X. P. P. P. P. P. P. +. +. D. P. P. P. P. +. +. P. P. +. X.
.....................................................................
128) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.
129) X. P. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.
130) X. D. P. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.
131) X. D. D. P. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.
132) X. D. D. D. P. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.
133) X. D. D. D. D. P. D. D. D. D. I. I. I. I. -. -. I. I. -. X.
134) X. D. D. D. D. D. P. D. D. D. I. I. I. I. -. -. I. I. -. X.
135) X. D. D. D. D. D. D. +. D. D. I. I. I. I. -. -. I. I. -. X.
136) X. D. D. D. D. D. D. -. D. D. I. I. I. I. -. -. I. I. -. X.
.....................................................................

 Next free production line = 10
 Next free dummy       line =137
```

FIG 12 : BASIC PERIOD TABLE 5

BASIC PERIOD NR 5

selfterminating production BP at 2/3 of intensity

	1	2	3	4	5	6	7	8	9	10
0	0	0	128	0	0	128	0	0	128	0
1	0	128	0	0	128	0	0	128	0	0
2	128	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	1	0	21	0	0	0	0

Nr of LIL periods in Basic Period = 21
Basic Period is self terminating

FIG 13 : INJECTION SCHEME LISTING

INJECTION SCHEME LISTING
****

0)	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
1)	1	3	5	7	1	3	5	7	1	3	5	7	1	3	5	7	1	3	5	7	1	3	5	7	1	3	5	7	1	3	5	7
2)	1	4	7	2	5	8	3	6	1	4	7	2	5	8	3	6	1	4	7	2	5	8	3	6	1	4	7	2	5	8	3	6
3)	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5	1	5
4)	1	6	3	8	5	2	7	4	1	6	3	8	5	2	7	4	1	6	3	8	5	2	7	4	1	6	3	8	5	2	7	4
5)	1	7	5	3	1	7	5	3	1	7	5	3	1	7	5	3	1	7	5	3	1	7	5	3	1	7	5	3	1	7	5	3
6)	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2
7)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8)	1	3	5	7	8	2	4	6	7	1	3	5	6	8	2	4	5	7	1	3	4	6	8	2	3	5	7	1	2	4	6	8
9)	1	3	5	7	2	4	6	8	3	5	7	1	4	6	8	2	5	7	1	3	6	8	2	4	7	1	3	5	8	2	4	6

Option 5) finishes the editing and asks the user where to store the data actually in memory.

1) Original sourcefile "filename"
2) Other filename
3) No restore done

Option 1) restores the edited data back into the file where the program got the initial data.

Option 2) asks for a new filename. If this filename does not yet exist, it will be created and the data will be copied in the newly created file. If the filename exists already, the program will ask if you want to overwrite the data in the file, if yes it is overwritten with the new data.

Option 3) does no restore at all, this means that after this command all data in memory are lost and the editor returns to the main menu.

The option 2) in the main menu generates a simulation listing of a Basic Period. This permits to check a constructed Basic Period for each equipment before implementing it actually in the IKBOX. An example of a simulation listing is showed in fig 14 : SIMULATION LISTING of Basic Period 5.

WARNING

The program is protected against all unpermitted input values. Every not permitted choice will force the editor to ask the question again. The only way to stop the program outside the menus is the ESCAPE button (left of the 1). The pressing of the ESCAPE button will force the NODAL program to stop and all the data in memory will be lost.

FIG 14 : SIMULATION LISTING OF BASIC PERIOD 5

```
BASIC PERIOD NR   5
*****************

selfterminating production BP at 2/3 of intensity


.....................................................................
 L . B. G. K. K. C. G. K. K. K. K. K. K. K. K. K. S. A. G.  .CST.
 I . K. U. L. L. O. U. L. L. L. L. F. F. F. F. F. F. M. C. U.  .   .
 N . L. N. Y. Y. N. N. Y. Y. Y. Y. I. I. I. I. E. E. H. C. N.  . LN.
 E . Y. V. 0. 1. V. W. 2. 2. 3. 3. 1. 3. 7. 9. 4. 5. 0. U. P.  .   .
 N .  .  . 3. 3.  .  . 5. 7. 1. 5. 1. 1. 1. 1. 9. 1. 0. M. R.  . NR.
 R .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  . 0.  .   .
   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  . D.  .   .
.....................................................................
  1) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
  2) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
  3) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
  4) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
  5) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
  6) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
  7) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
  8) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
  9) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
 10) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 11) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 12) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
 13) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 14) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 15) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
 16) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 17) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 18) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
 19) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 20) X. P. P. P. P. P. P. +. +. P. P. P. P. P. +. +. P. P. +. X.  0.
 21) X. D. D. D. D. D. D. D. D. D. I. I. I. I. -. -. I. I. -. X.128.
.....................................................................

Nr of LIL Periods in the Basic Period =    21

Basic Period is self-terminating
```

3.3 DOWNLOAD TO THE IKBOX

To copy the datatables generated by the editor into the SMACC one has to call a program under the REMOTE COMPUTER option in the "apple" menu. This will start up the NODAL in the SMACC (the McIntosh has to be connected with the SMACC via the frontpanel RS232 port). After the NODAL prompt (>) one types "RU DOWN". The first and only question the program asks is the filename where to get the data from on the diskette in the McIntosh. The program will force the IKBOX in the DUMMY state until the transfer of the datatables is finished. The transfer takes about 4 minutes. During transfer regularly messages are displayed on the McIntosh screen. When the datatranfer is finished the IKBOX will start normal operation again on the next Start Cycle interrupt (FPI2) of the SMACC.

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Distibution list

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J.P. Delahaye
B. Frammery
K. Hubner
I. Kamber
B. Kuiper
J. Lewis
Ch. Serre
P. Schenkels

FIG 11 : BASIC PERIOD TABLE 4

BASIC PERIOD NR 4

example of an electron production cycle at full intensity

	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	128	128	128	128	128	128
11	128	128	128	128	128	128	128	128	128	128
12	128	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	2	0	120	0	0	0	0

Nr of LIL periods in Basic Period = 120
Basic Period is NOT self terminating