RM/lp

PS/BT/Note 82-12

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CONTROLS OF THE FAST EJECTION-INJECTION SEPTUM MAGNETS (SM 16, 58, 74)

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GENERAL

The septum magnets 16, 58 and 74 are part of the ejection-injection process of the PS accelerator, ref. 1,2.

SM 16 is normally used either to eject protons to the ISR and SPS machines or for AA antiproton production. It is also used to inject into the PS antiprotons coming from AA.

SM 58 can furnish protons to the West Hall or antiprotons to the SPS and ISR, or reinject protons from the SPS to the PS.

SM 74 is, at present, a stand-by equipment.

These systems need somewhat sophisticated control because of the various modes of operation.

This is why it was necessary to change the previous control system.

CONTROL NETWORK DESCRIPTION

With the KFA 71/79 new control system we already dispose of three free control channels, ref. 3.

In order to be able to put quickly the SM systems into operation without doing too much work, we decided to use the facilities offered

by this solution, i.e., assign channel 13 to SM 16, channel 14 to SM 58 and channel 15 to SM 74.

This solution provided us with the following advantages :

- existing CAMAC interface,
- control protocol already known,
- easy link with the KFA 71/79 central processor (K.S.U.),
- possibility of local independent control via a local console,
- little development for the hardware side.

The local control systems are made in the same way as the microprocessor modules of the KFA 71/79 system. The hardware was furnished by Panel S.A.

As shown on Fig. 1, the control of the SM systems is made via a Main Control Room console which drives the CT PDP computer linked to CAMAC with a parallel CAMAC driver. This branch is extended by a serial CAMAC loop to enable long distance communication. The CAMAC crate controlling the central processor unit (named Kick Strength Unit or KSU) is on this serial branch with address number 20. The KSU is interfaced to CAMAC for control by a dual sixteen words sixteen bits output register, and for acquisition by a 256 words input memory (JMT 30). The data dispatching is done by the KSU and sent to or received from the local control modules via a serial control link RS232(V 24), with 9600 baud rate speed.

The KSU can also be controlled by a local console which has the same priority as the one in the Control Room. More details on the Central Control Network are given in Ref. 3,4.

CONTROL MCR

The controls of the SM systems are operation oriented for the reference values and current acquisition which means that to introduce changes the operator must choose :

- from the main page : the operation required (Fig. 2), when the terminal will then display the equipments which can be controlled (Fig. 3),

- from this new page : the septum magnet option, when the terminal will then display a new list of options concerning the septum magnet attached to the operation selected (Fig. 4), and simultaneously TV2 screen will display the entire table of refreshed status, acquired currents and mechanical positions (Fig. 5).
- the current can be modified only for the operation selected previously; power commands or new mechanical positions act for all operations in which this septum is concerned.

LOCAL CONSOLE

The local console attached to the KSU offers the same possibilities as the MCR one, but to obtain an acquisition refresh, the operator should ask, at anytime, the general SM display which will be displayed directly on the terminal screen. An example is given in Fig. 6.

CENTRAL CONTROL PARAMETER LIST

1. Control Words
   - 16 current reference words (8 for SM 16, 5 for SM 58 and 3 for SM 74)
   - Power command words (one for each SM)
   - 9 mechanical position reference words (3 for each SM)

2. Acquisition Words
   - 16 current acquisition words (same as references)
   - 3 status equipment words (same as commands)
   - 3 status mechanical words (one for each SM)
   - 3 flag operation words (one for each SM).

LOCAL CONTROL MODULE

1. Hardware

   The hardware consists of a standard "Europa" frame equipped with a Mubus for a 6800 microprocessor, ref. 5. The cards fitted are of a standard Panel production, except for a relay card and OP/AMP sampling/hold cards which were developed at CERN. The detail of the layout is given in Fig. 7.

2. Software

The software implemented at this level has two different modes of running :

- complete real time task controlled by a local IRQ system and by the central processor unit. In this mode the access to the equipment can be made only as previously described.

- partial real time task controlled by an additional console connected directly to the module. This enables the equipment specialists to work in "stand alone" mode. This mode can also be activated by a specialist program from the central processor unit (KSU).

To give an idea of the size of the microsoftware we can say that :

- memory space occupied in the central processor unit is 8 kbytes
- memory space at the module level is 4 kbytes.

REAL TIME TASK DESCRIPTION

Each module receives from the KSU the reference current in ppm mode. This action is triggered by a keyword sent to the module at each PS cycle. The module checks the new reference and, if the value is within range, sends it to the external DAC register.

Before loading the DAC, the power supply status is checked. If something is wrong a flag is set, an automatic sequence of restore is started and, if the equipment is then ready, the DAC is loaded and the charge is started. The flow of acquired data is sent to the KSU. Otherwise all operations are stopped and a warning flag is sent to the KSU.

The IRQ task is started by a timing pulse (warning SM) which stops the charge of the power supply. The microprocessor acquires the voltage of the primary capacitor and enables the power supply to accept a discharge trigger.

The discharge trigger begins a new IRQ task which acquires the load current with a sampling/hold sequence. The values acquired will be sent to the KSU at the next sequence of reference loading.

The power commands and the mechanical position are handled by a background program. Commands arrive in asynchronous mode and mechanical movements are too slow to wait for the execution from the central console; they are managed by the local micro.

As can be seen from the above, this interface is not only a passive one; some decision can be taken at the module level. The data are treated and checked locally. Only the important parameters are transmitted to the operator.

DEVELOPMENT TIME

Hardware : 2 months
Software : 1 month
Price : 18 kFrs.

ACKNOWLEDGEMENTS

We would like to thank D. Boimond for his help concerning the movement systems of the septum magnets.

Distribution :

O.S. Section
S.M. Section
R. Bertolotto, L. Coull,
D. Fiander, B. Kuiper, B. Nicolai

REFERENCES :

[1] Alimentation FPG 16 pour éjection rapide en section droite 16
Note PS/AE/76-9
R. Bertolotto, B. Boileau, G. Molinari

[2] Alimentation FPG 58 et FPG 74 pour éjection rapide en sections droites 58 et 74
Note PS/AE/76-10
R. Bertolotto, B. Boileau, G. Molinari

[3] Nouveau contrôle du déflecteur rapide KFA 71/79 (FAK)
Note PS/EI/80-16
R. Maccaferri

[4] Contrôle des éjections rapides et des opérations APA (Antiprotons production and acceleration)
Note PS/EI/80-15
J. Boucheron

[5] "Système 802 a microprocesseurs" Panel S.A.

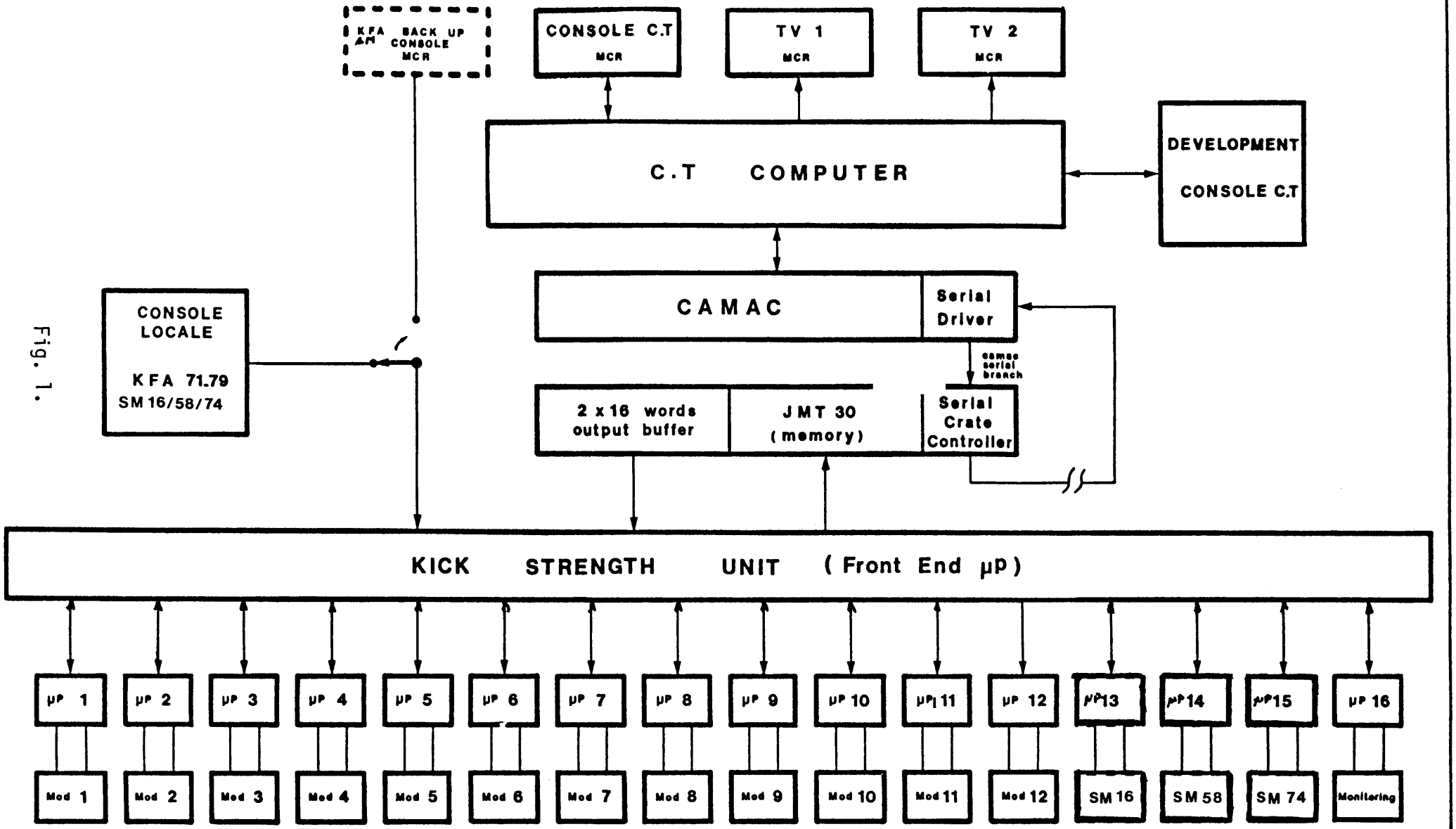

Fig. 1.

SELON NORMES ISO

INDICE	DATE	NOM	ZONE	MODIFICATION

KFA 71.79 SM 16/58/74

GENERAL CONTROL DIAGRAM

ECHELLE SCALE

DESSINÉ CHAMPEAU-R 10.12.80

CONTRÔLE

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INDICE

PS _ EI _ KM

```
                              MAIN PAGE                                (HOME)

            ------------ PROGRAM PAGE OPTIONS ------------

 1     16C     CT TO SPS          !    9      58E   _ FE58 TO EAST HALL
 2     16S     FE16 TO SPS        !   10      58S   P FE58 TO SPS
 3     16I     FE16 TO ISR        !   11      T58   _ TEST REINJ 58 FROM SPS
 4     16A     FE16 TO AA         !   12      58I   P FE58 TO ISR
 5     16T   _ FE16 TEST AA       !   13      58R
 6     A16   P AA TO INJ 16       !   14      74E
 7     KIL     FE KILL            !   15      74R
 8     16R                        !   16      TST

 0     EXIT FROM ESAU
 ================================================================================
       PROGRAM PAGE ?:1
```

Fig. 2.

```
                          RANGE   0  TO  16
```

```
                              CT TO SPS                    PP100

            -------- PROGRAM OPTIONS --------

  1    TIMING                      !    7      MBIH
  2    AUXILIARY POWER SUPPLIES    !    8      TT2
  3    SEPTUM MAGNET               !    9      ES31
  4    KFA 71                      !   10      2 OR 3 TURN FB (BFA 21/77)
  5    5 TURN FAST BUMP            !   11      CT OPTIMISATION
  6    BEAM DIAGNOSTICS            !

  H OR <CR>    RETURN TO MAIN PAGE
 ================================================================================
       PROGRAM ?:3
```

```
                          RANGE   1  TO  11
```

Fig. 3.

```
                    SM 16   SEPTUM MAGNET          16C   PP = 103
                    ---------------------

F       FUNCTION                    REF       FUNCTION

     ADJUST CURRENT              ¦   7    SPECIALIST FUNCTIONS
     POWER COMMANDS              ¦
     ADJUST RADIAL POSITION      ¦
     ADJUST ANGLE                ¦
     ADJUST VERTICAL POSITION    ¦
     DISPLAY INTERLOCKS          ¦

R>   RETURN
================================================================================
NCTION REQUIRED  ? :
```

Fig. 4.

RANGE 1 TO 7

```
                                                    11:33:35    12/11/82

     SM16   SEPTUM MAGNET
     ------------------

     OPERATION      CURRENT [KA]   SUB
     NUM  MNEM       REF    AQN   CYCLE  STATUS
     ------------------------------------ ------
>>>  1    16C        6.70     *     *    ON
     2    16S       17.85     *     *    REMOTE
     3    16I       17.90  18.00   12
     4    16Q       17.90  18.00    1
     5    16T        2.52     *     *
     6    A16        2.52     *     *
     7    KIL         .0     *     *
     8    16Q       10.52     *     *

     POSITION       REF    AQN          STATUS
     ----------------------------------------
     RADIAL [MM]   58.0   57.6
     ANGLE [MRAD]   1.6    1.6
     VERTICL [MM]    .0    -.1
```

TV. 2.

Fig. 5.

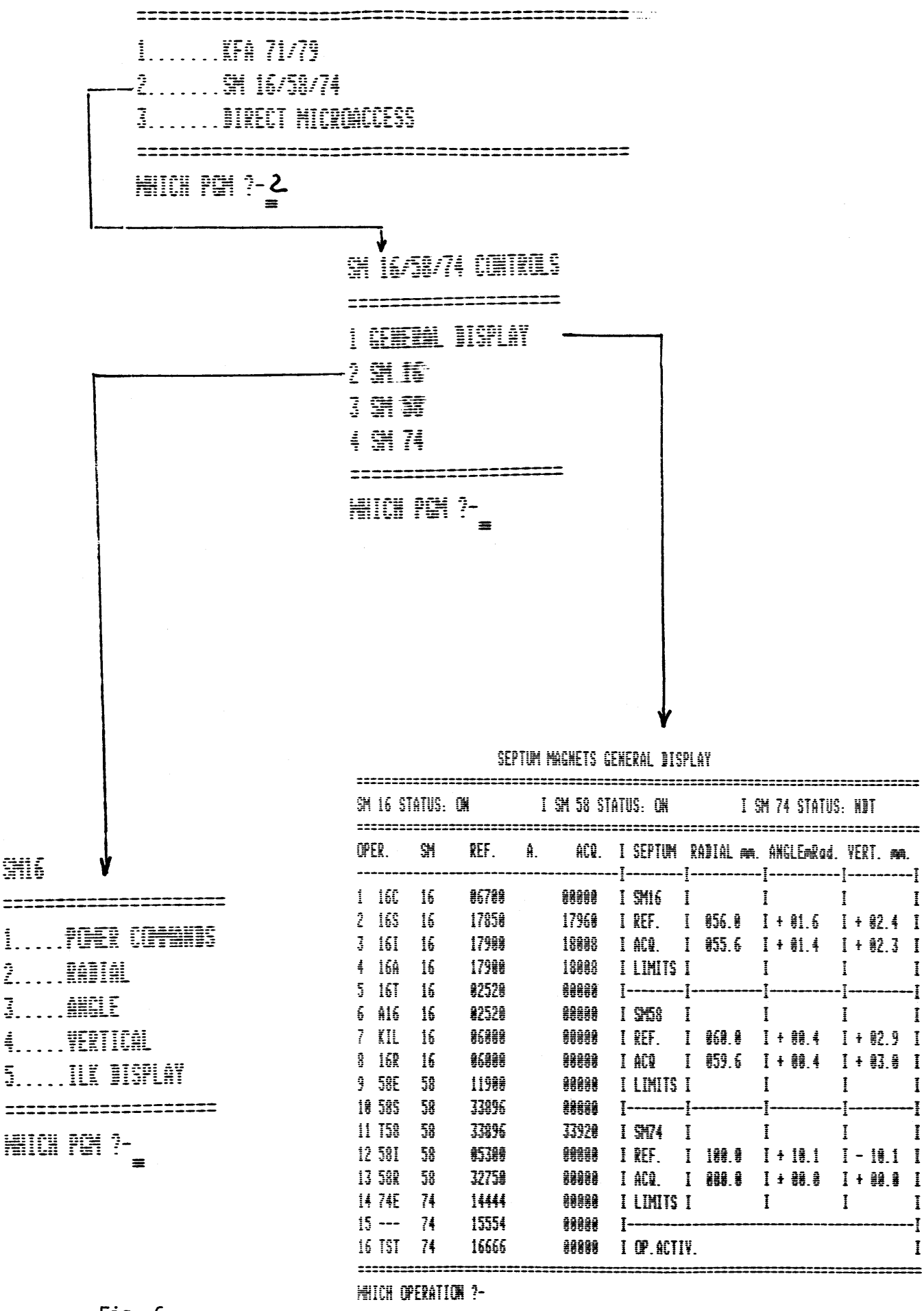
1.....XPA 71/79
2.....SM 16/58/74
3.....DIRECT MICROACCESS
MATCH PGM ?-2
SM 16/58/74 CONTROLS
1 GENERAL DISPLAY
2 SM 16
3 SM 58
4 SM 74
MATCH PGM ?-
SM16
1.....POWER COMMANDS
2.....RADIAL
3.....ANGLE
4.....VERTICAL
5.....ILK DISPLAY
MATCH PGM ?-
SEPTUM MAGNETS GENERAL DISPLAY
SM 16 STATUS: ON
SM 58 STATUS: ON
SM 74 STATUS: NOT
OPER. SM REF. A. ACQ. I SEPTUM RADIAL mm. ANGLE=Rad. VERT. mm.
1 16C 16 06700 00000 I SM16 I I I I
2 16S 16 17050 17960 I REF. I 056.0 I + 01.6 I + 02.4 I
3 16I 16 17900 10000 I ACQ. I 055.6 I + 01.4 I + 02.3 I
4 16A 16 17900 10000 I LIMITS I I I I
5 16T 16 02520 00000 I SM58 I I I I
6 A16 16 02520 00000 I REF. I 060.0 I + 00.4 I + 02.9 I
7 KIL 16 06000 00000 I ACQ I 059.6 I + 00.4 I + 03.0 I
8 16R 16 06000 00000 I LIMITS I I I I
9 58E 58 11900 00000 I SM74 I I I I
10 585 58 33896 00000 I REF. I 100.0 I + 10.1 I - 10.1 I
11 T58 58 33896 33920 I ACQ. I 000.0 I + 00.0 I + 00.0 I
12 581 58 05300 00000 I LIMITS I I I I
13 58R 58 32750 00000 I OP.ACTIV. I
14 74E 74 14444 00000 I
15 --- 74 15554 00000 I
16 TST 74 16666 00000 I
MATCH OPERATION ?-

Fig. 6.

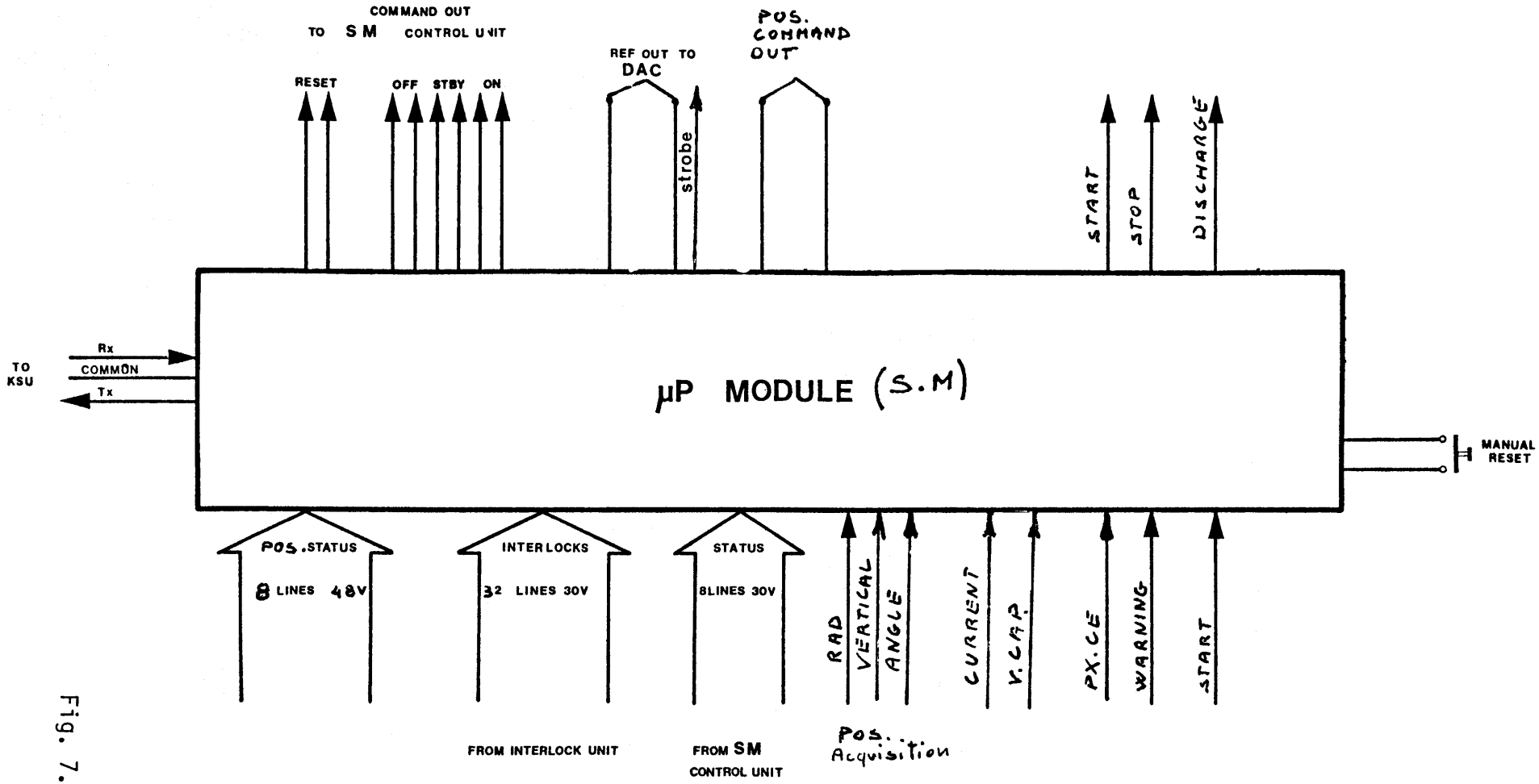

Fig. 7.

DESSIN RUGOSITE TOLÉRANCES SELON NORMES ISO

Projection européenne
First angle projection

INDICE	DATE	NOM	ZONE	MODIFICATION

µP MODULE (S.M.)

ECHELLE SCALE

DESSINÉ SCHEFFRE C 10-12-80
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