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ISOLDE 3 CONTROL LAYOUT

GP.Benincasa - H.Lustig - Cl.Richard-Serre

Geneva, Switzerland

FOREWORD

The presented layout is now the definitive one.

Most of the ISOLDE 3 systems are still in construction but their control philosophy has been frozen.

Small modifications are still possible in the future: neverthless this layout permits the different persons involved in the project to have a whole idea of what has been discussed and approved, and it can also be used as working paper for future discussions.

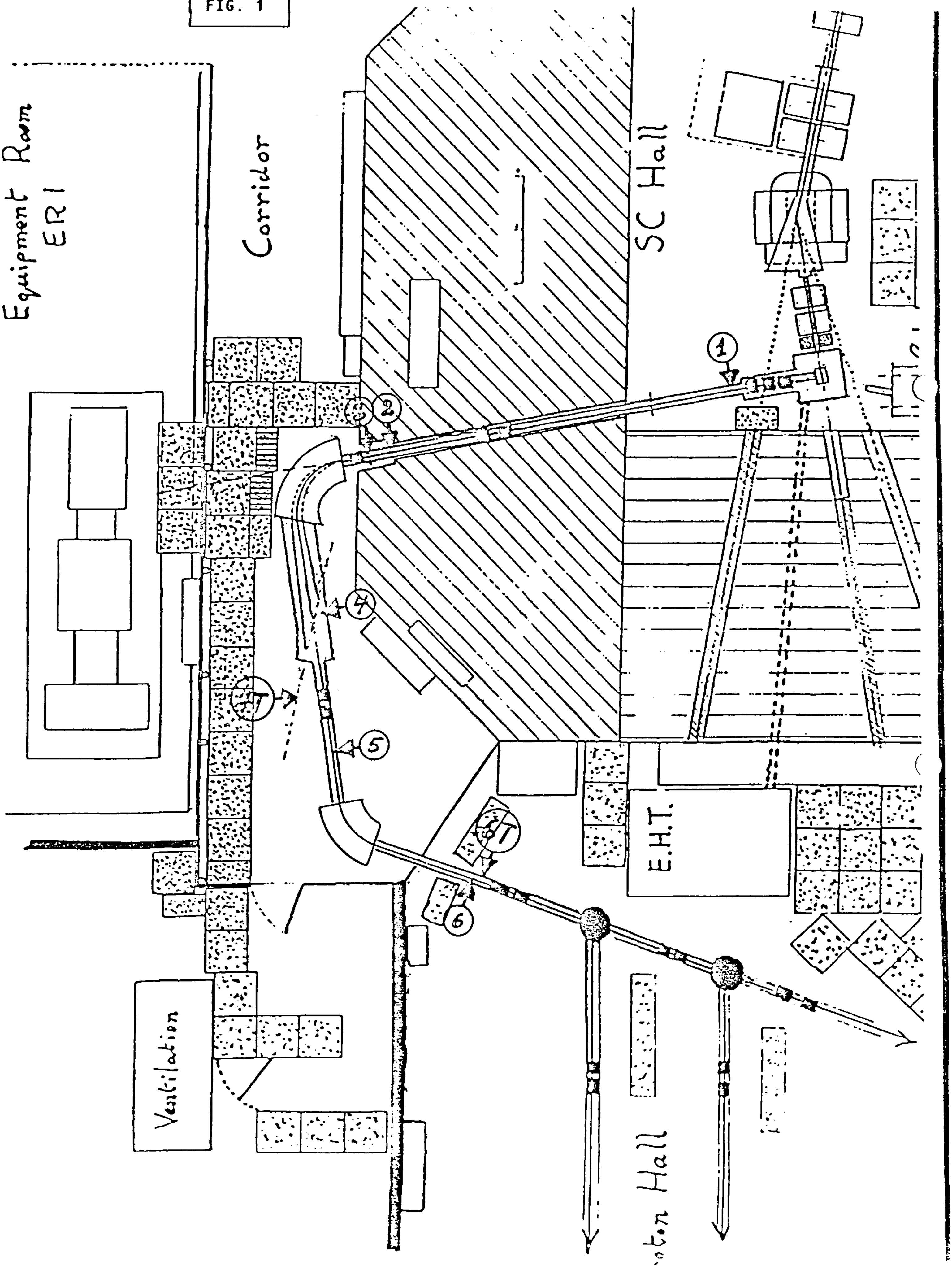
The ANNEXE 1 contains a description of the control computer and its hardware modules, and presents the layout of the control room with its three consoles.

In the ANNEXE 2 there is a description of the Equipment Modules (EM) and their use.

In ANNEXE 3 the use of Mac Intosh as tool for hardware test is described.

In ANNEXE 4 is contained the naming structure for ISOLDE 3 elements.

FIG. 1


Equipment Room
ER1
Corridor
SC Hall
E.H.T.
Ventilation
ton Hall
1
2
3
4
5
6
ST
ST

1- INTRODUCTION

1.1 Design specifications

The present layout is principally the results of a serie of meetings that the concerned people had during the spring and summer 1985.

These meetings were called I3CCM for ISOLDE 3 CONTROL COMPUTER MEETING. The meetings were obviously followed by numerous contact and informal discussions with the specialists.

The following persons participated in the discussions:

- G.Benincasa	(PS)	permanent members
- H.Lustig	(PS)	
- H.Ravn	(EP)	
- Cl.Richard-Serre	(EP)	
- B.Allardyce	(PS)	present where concerned
- K.Gase	(PS)	
- T.Jené	(PS)	
- O.Jonsson	(EP)	
- M.Knipfel	(Strasbourg)	
- E.Kugler	(EP)	
- S.Sundell	(EP)	
- B.Vosicki	(EP)	

1.2 Design criteria

Serial CAMAC is used as transmission system. This permits to use the large spectrum of modules existing for the PS controls.

The advantage is that a deep experience exists on this standard interface and help can be provided in maintenance and in repairing inside the division.

A particular care has been given to the maintenance problems: standardization and the function separation have proved their utility in fault diagnostics and in maintenance. For example, standardization in power supplies controls means that, independently of their different characteristics and use, they all are controled by the same hardware and software modules.

Function separation is obtained by assigning different hardware modules, or at least different registers inside the same module, to different activities or functions. In the total controls design this will cost a few extra CAMAC modules, but the software design and the fault diagnostics will be eased and improved.

Hardware and software have been designed at the same time: the results is a most homogeneous design that is optimized on both aspects considered as a whole. This is particularly important for ISOLDE 3 where the NODAL language is used: interpretive languages are slow and an appropriate hardware arrangement is required to compensate, where possible, this weakness.

The presented design is flexible and expandable. Serial CAMAC permits to easily add new crates and room is left in the existing ones.

Software modularity (Equipment Modules, sec.4.1) allows new elements of the existing type to be added in practice at no cost.

1.3 Naming structure

A naming structure, based on the so-called OSCAR BARBALAT standard (O.B.names), has been proposed and approved for the different elements of the ISOLDE 3 systems. See list in ANNEXE 4.

2- CONTROL ARCHITECTURE

2.1 Computers and consoles

The computer system is based on a SPS developed ICC (Independent Crate Controller) module housed in a CAMAC Crate (mother crate). This module contains a Motorola 68000 microprocessor and is used with a memory module containing the application software. In the same crate is housed a MMC (Man Machine Interface) and other modules providing facilities to drive touch screen, knobs, display, track-ball and buttons.

The only used programming language is NODAL.

More details on the control computer and console organisation are contained in ANNEXE 1.

2.2 SYSTEMS List

The identification of the different systems was done at the start of the control project.

A system is a subprocess that functionally and operationally can be controlled in an independent way. The subdivision in systems is very important for hardware layout design and for application programs implementation.

Ten separate systems have been identified:

- Vacuum system
- Analysing magnets
- Beam Transport, including:
    - quadrupoles
    - X-Y plates (dipoles)
    - deflectors (bending)

- ION source + target

- High Tension (Faraday cage)
- Isolation transformer
- Extraction electrodes movements
- Tape transport
- Beam diagnostic
- (Squirrel cage multipoles).

The last system is not included in the present layout. For the time being it is controlled in a separate way.

2.3 Repartition in CAMAC LOOPS

The control system has three serial CAMAC loops: each loop will be controlled via a console with interactive devices (fig.2).

There are no connection between the three loops. It is then essential to allocate the different systems to one or another loop in such a way that it permits concurrent control where required. In other words the main criterium is: put in the same loop systems that have not to be controlled at the same time.

The following repartition has been adopted:

- in CONSOLE 1,
    - the Vacuum system,
    - the Tape transport,
    - the beam diagnostic.

  Three crates, one per each system, are installed (fig 3.)

- in CONSOLE 2,
    - the HT (Faraday cage),
    - the Isolation transformer,
    - the Ion source + Target

  Two crates are installed in CONSOLE 2 (fig 4).

  The first crate contains the control modules for the 60 KV of the Faraday cage and for the isolation transformer.
  In the second crate are housed the modules for the control of the Ion source and the Target power supplies.

  One is obliged to provide two separate crates because the second one is installed inside the Faraday cage (at a 60 KV ground level) and is connected to the loop via an optical link.

- in CONSOLE 3,
    - the Analysing magnets,
    - the Beam transport elements,
    - the Extraction electrode movement control

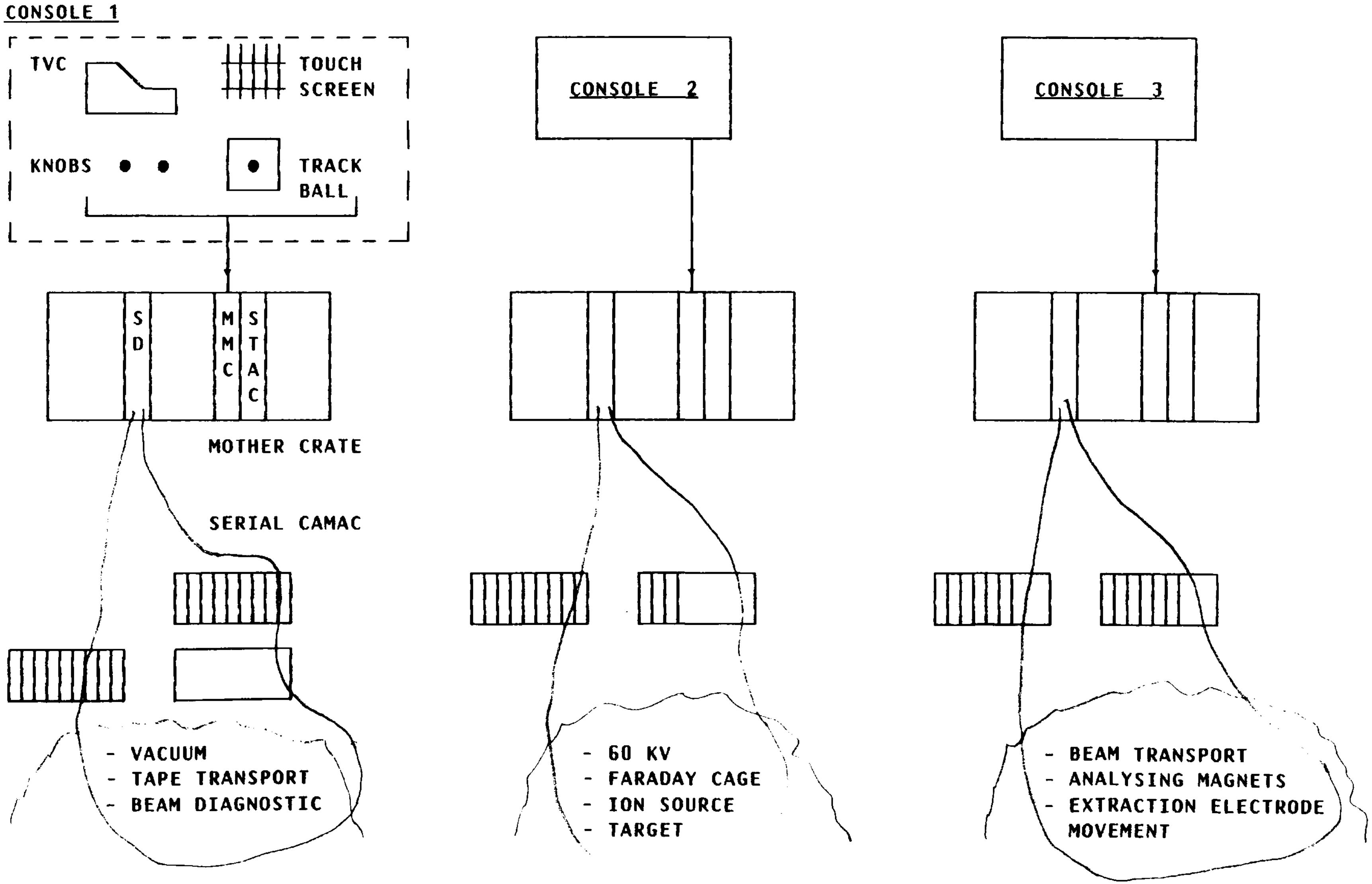
  Two crates are installed: the first one for the element of the separator zone and the other one for the experimental zone (fig. 5).

The subdivision eases the maintenance and permits, if required, a clean implementation of controls in slices.

ISOLDE III CONTROL SYSTEM

PRESENT LAYOUT

FIG.2



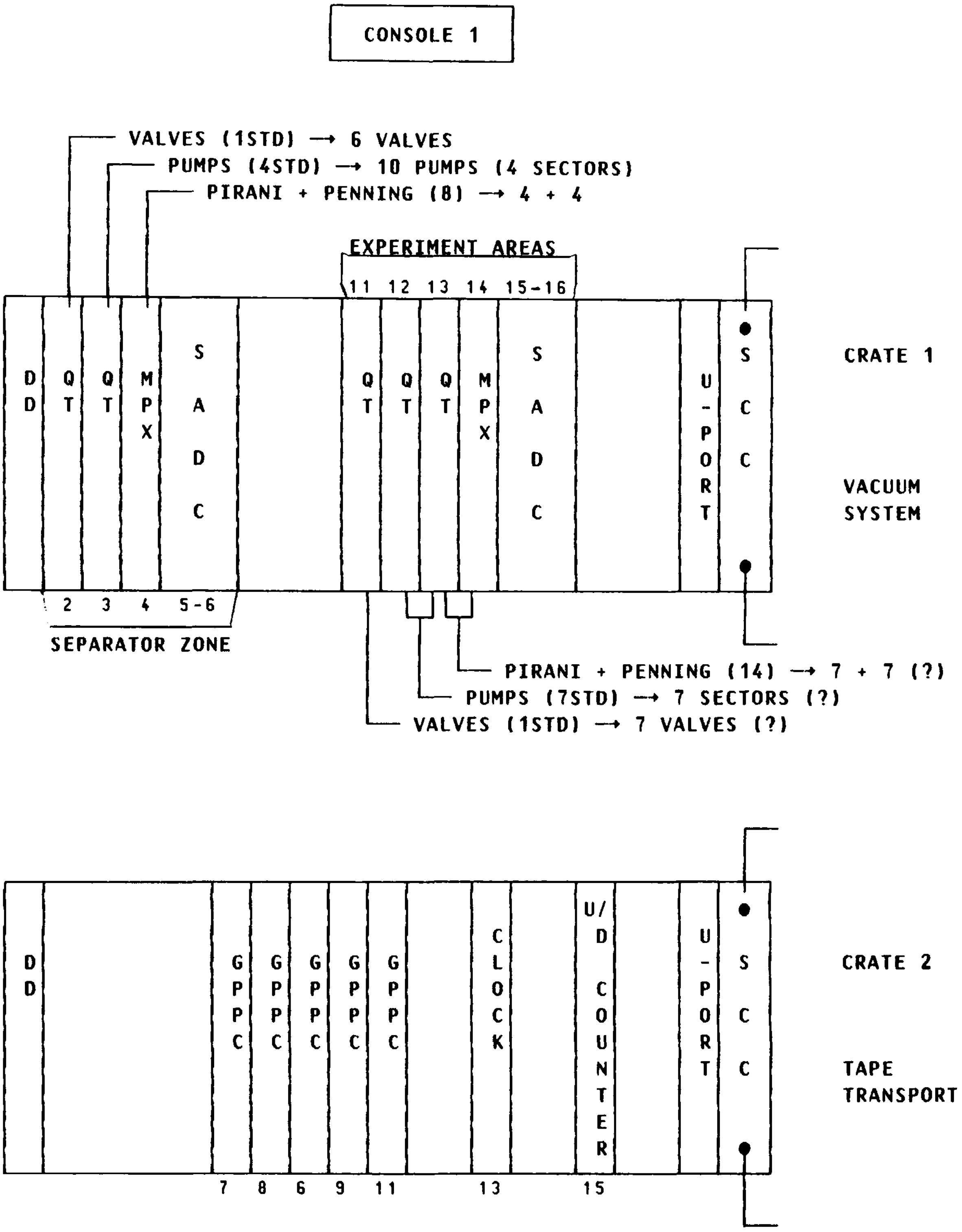

CONSOLE 1
VALVES (1STD) → 6 VALVES
PUMPS (4STD) → 10 PUMPS (4 SECTORS)
PIRANI + PENNING (8) → 4 + 4
EXPERIMENT AREAS
11 12 13 14 15-16
DD
QT
QT
MPX
SADC
QT
QT
QT
MPX
SADC
U-PORT
SCC
CRATE 1
VACUUM SYSTEM
2 3 4 5-6
SEPARATOR ZONE
PIRANI + PENNING (14) → 7 + 7 (?)
PUMPS (7STD) → 7 SECTORS (?)
VALVES (1STD) → 7 VALVES (?)
DD
GPPC
GPPC
GPPC
GPPC
GPPC
CLOCK
U/D COUNTER
U-PORT
SCC
CRATE 2
TAPE TRANSPORT
7 8 6 9 11 13 15

FIG. 3.1

CONSOLE 1

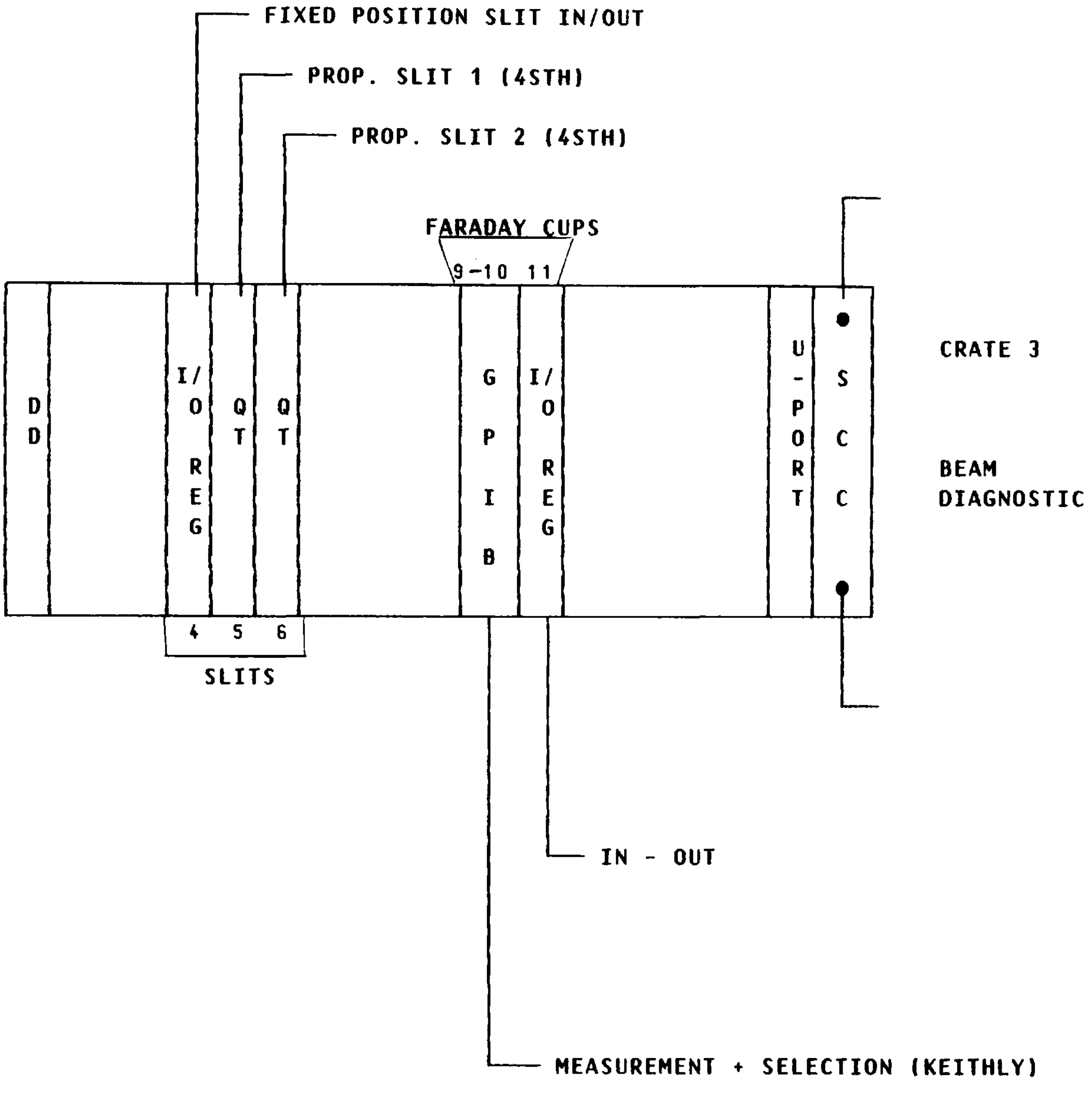


FIG. 3.2

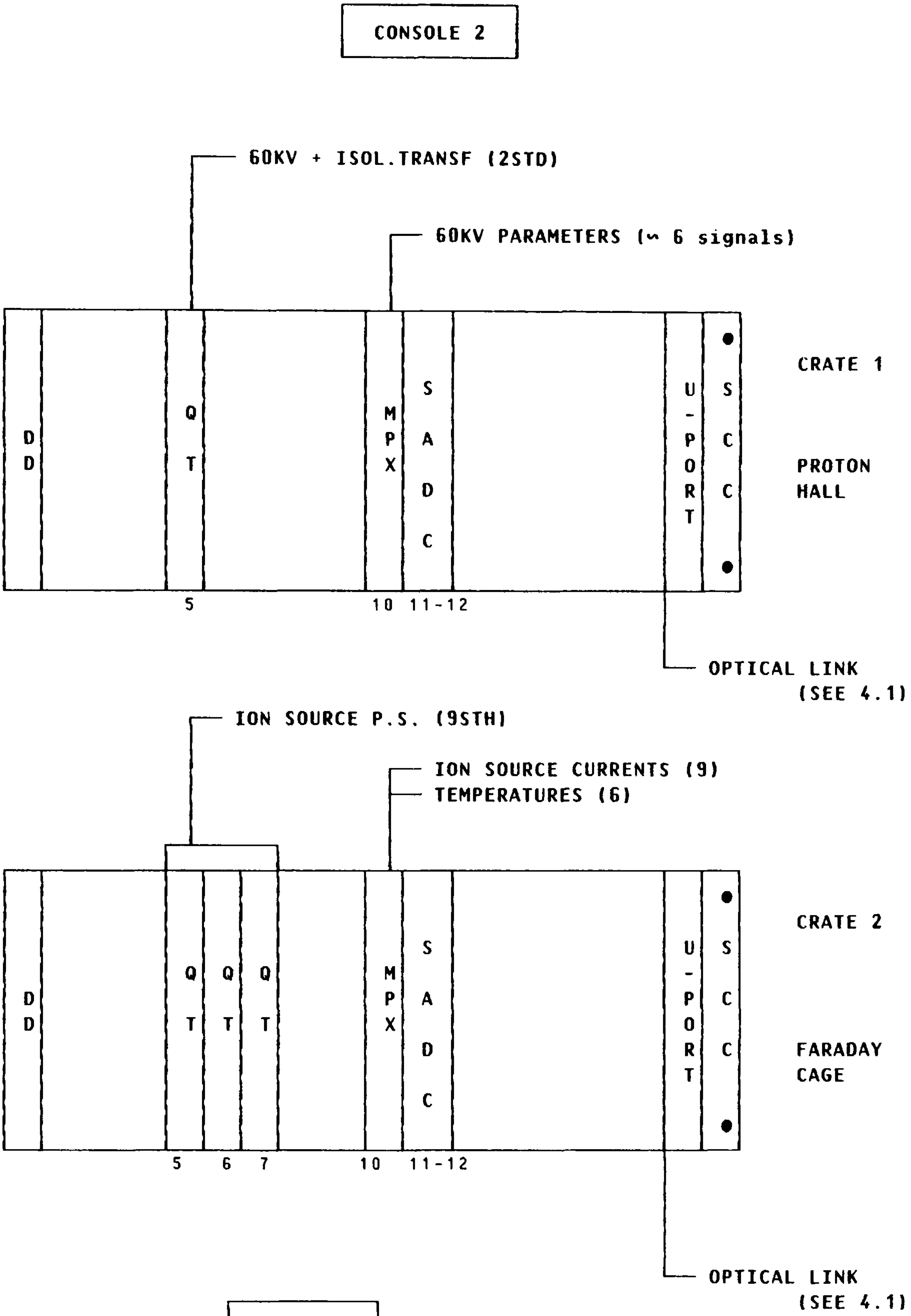

CONSOLE 2
60KV + ISOL.TRANSF (2STD)
60KV PARAMETERS (~ 6 signals)
DD
QT
MPX
SADC
U-PORT
SCC
5
10
11-12
CRATE 1
PROTON HALL
OPTICAL LINK (SEE 4.1)
ION SOURCE P.S. (9STH)
ION SOURCE CURRENTS (9)
TEMPERATURES (6)
DD
QT
QT
QT
MPX
SADC
U-PORT
SCC
5
6
7
10
11-12
CRATE 2
FARADAY CAGE
OPTICAL LINK (SEE 4.1)

FIG. 4

OPTICAL LINK

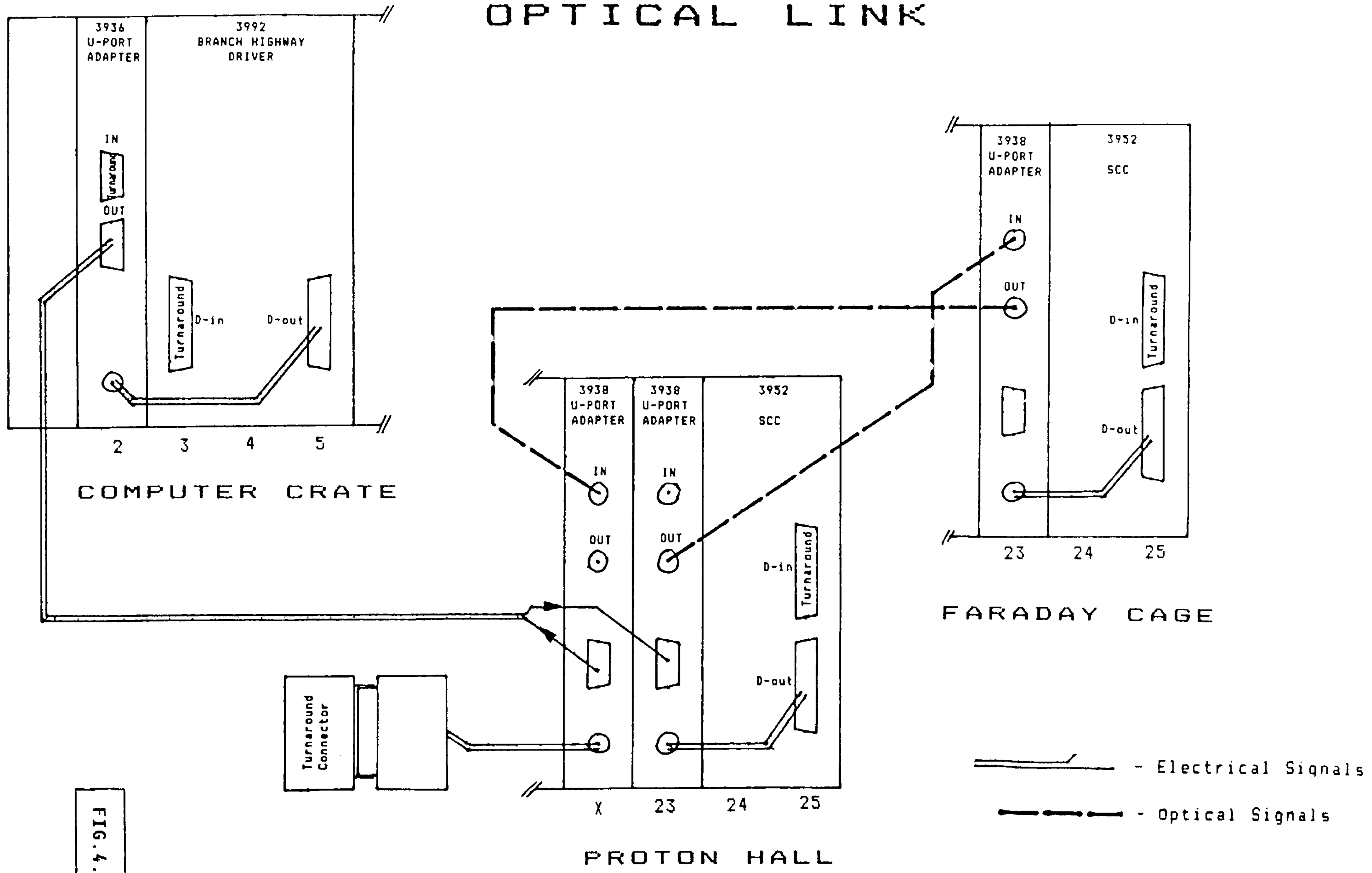
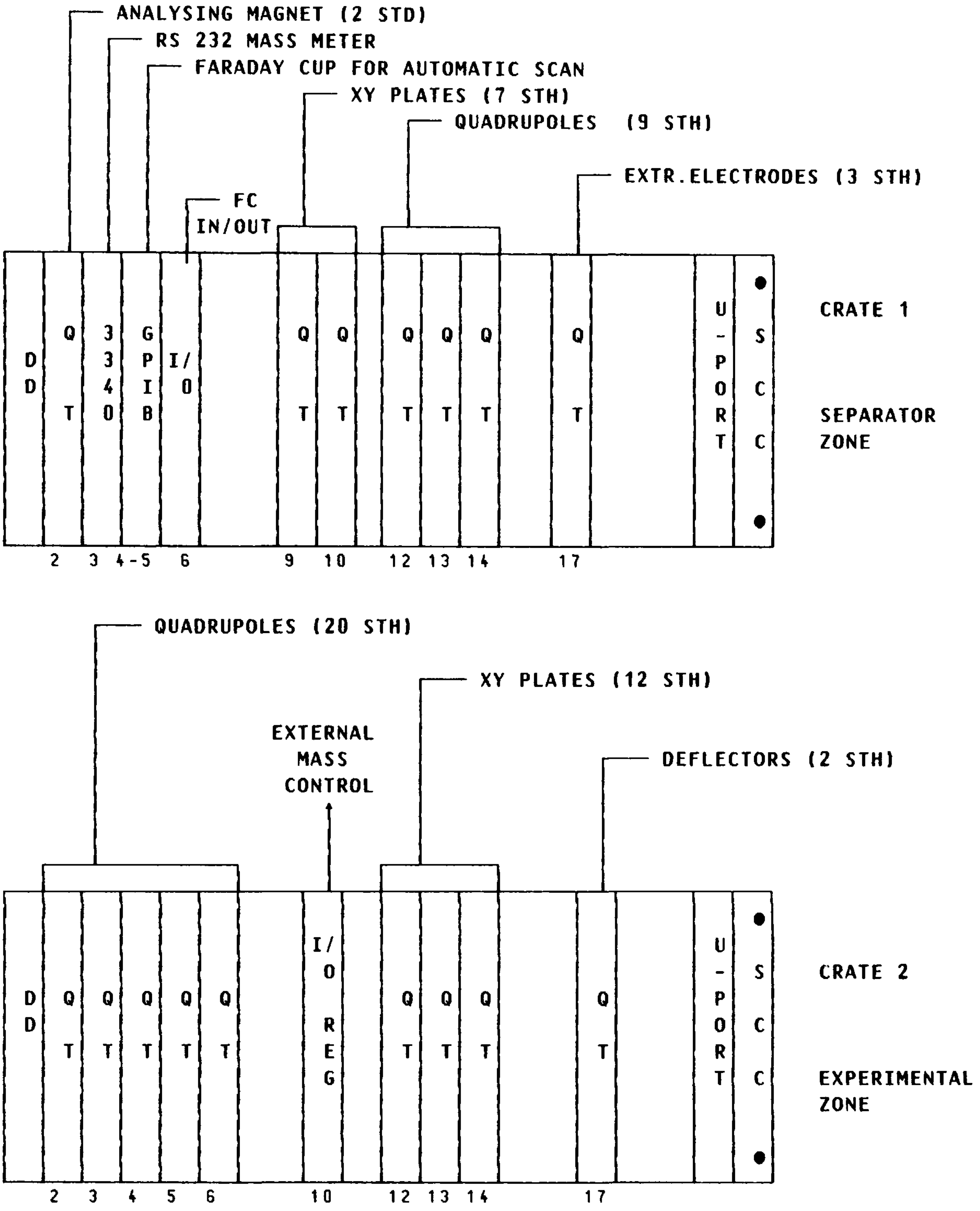


FIG.4.1

GJF 86211

CONSOLE 3



BEAM TRANSPORT

FIG. 5

2.4 LOCAL CONTROL

For equipment testing, for maintenance purposes and during the commissioning period, it is very useful to have a local control facility.

In the ISOLDE 3 control system two kind of local control are foreseen:

- at the level of a single equipment,
- at the level of a complete CAMAC crate.

In both cases it is essential that the Main Control Room is informed if an element is in local control.

In the first case (see fig.6 for more details) each specialist should provide a manual switch permitting to connect alternatively the device to the standard control module (in the example a Single Transceiver) or to a local control. Connected to this switch there is a LOCAL/REMOTE bit activated in the register C of the Single Transceiver. In this case the SURVEY program will immediately detect and display the abnormal situation.

In the second case, it is proposed to use a mobile console based on a MACINTOSH microcomputer (see F.Di Maio, MACINTROTTE PS/CO Note 85-01). ANNEXE III.
This console takes in charge a complete CAMAC crate previously disconnected from its camac loop. Using the NODAL interpreter, all CAMAC tests are then possible. In this case any application program or the Survey program will detect that the crate is disconnected and the message "SERIAL LINK DISCONNECTED" will be displayed on the concerned console.

2.5 Future Improvements

The proposed control system, based on three independent consoles driving camac loops, constitute a sufficiant answer to the basic user requirements.
Neverthless this configuration has a certain number of limitations coming essentially from two characteristics of the system:

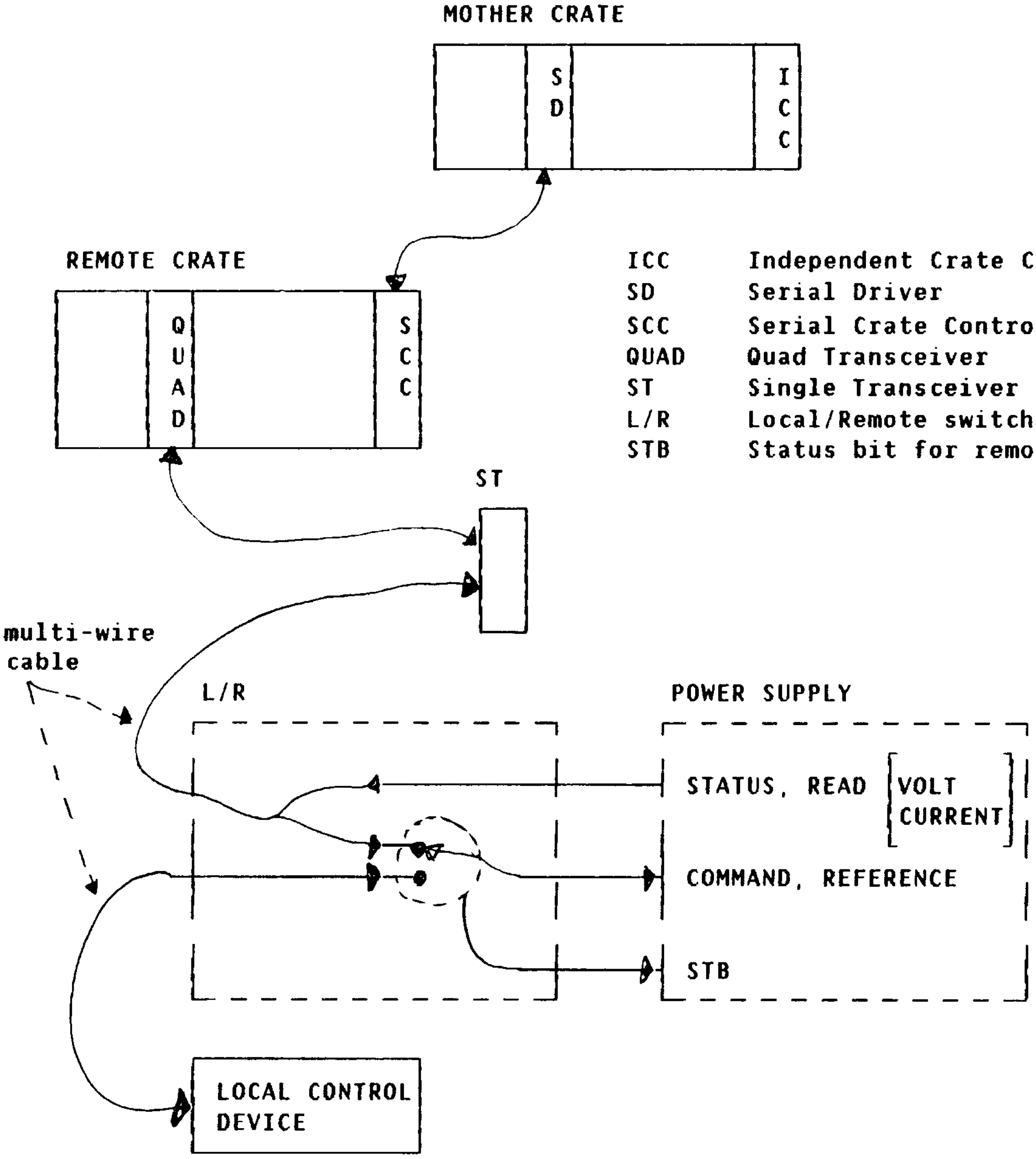
- there is no communication between the three loops,
- the ICC module provides limited real time capabilities.

A) A program running in one console cannot have informations on parameters belonging to another CAMAC loop.
This is a weakness, e.g., for SURVEY system that needs the acquisition of a large number of parameters to provide a minimum consequential fault analysis.
Other examples are the measurement programs where one usually wants to adjust at the same time other parameters (beam transport, analysing magnets, source etc...)

B) The software running in the ICC will consist of a big, monolitic NODAL program. This program is in charge of all interaction and control activities of the concerned console.

22.04.1985

LOCAL/REMOTE CONTROL PHILOSOPHY



ICC	Independent Crate Controller
SD	Serial Driver
SCC	Serial Crate Controller
QUAD	Quad Transceiver
ST	Single Transceiver
L/R	Local/Remote switch
STB	Status bit for remote/local

For local control the user has to put the L/R switch in the "LOCAL" position. This action disconnects only the command register (register A1) and the register for the reference value (register B) from the power supply. The status register (register C1 + C2) and the register for reading the voltage or the current (register D) remain active. For this reason it is possible to see in the control room what is going on locally.

FIG . 6

ISOLDE III CONTROL SYSTEM
PROPOSED LAYOUT

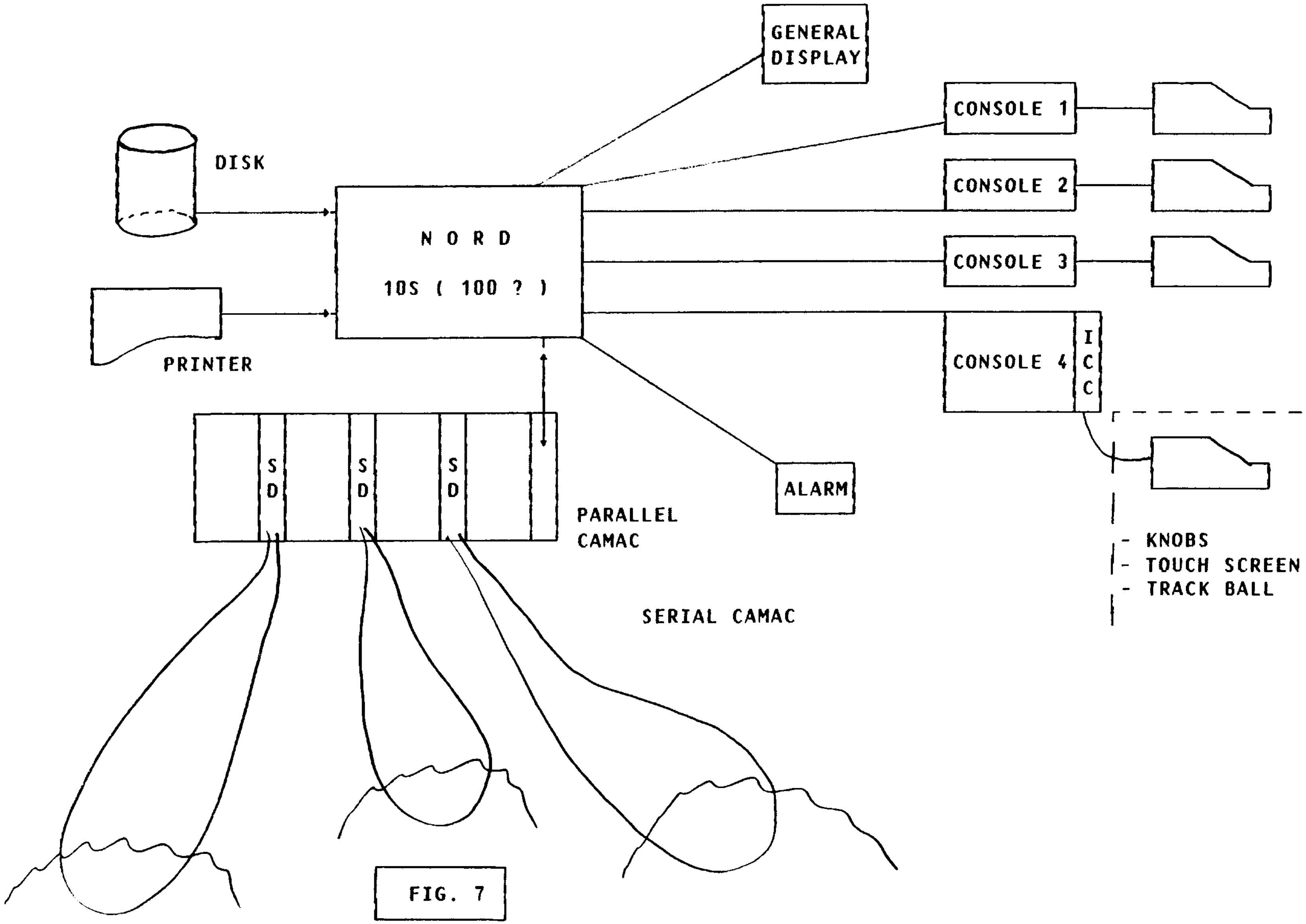


FIG. 7

In particular it has to serve the console devices (track ball, touch screen, knobs, keyboards etc...), it has to call and execute the requested applications, it has to generate the displays and the control actions etc...
No scheduled tasks are allowed such as repetitive display or survey scan programs and the event driven facilities are very limited.
This requires particular care in the design of the programs structure and severe restrictions are imposed to obtain acceptable execution times.

As a consequence no CLOSED LOOP CONTROL programs are advisable in such configuration, and the use of SOFTWARE INTERLOCKS is excluded. In the first case a console with its loop would be completely occupied for very long time, and in the second case no grant exists for the execution of the interlock treatment in real time.

An alternative layout design is presented in fig.7. (a similar solution has been implemented in the AA controls). A central computer (e.g. a NORD-100) communicates with the three serial CAMAC loops via a parallel crate. Up to four consoles can be connected to the computer: each console offers essentially the same facilities as the present ones.
The previously discussed limitations disappear in this configuration.

Additional advantages are:

- the CAMAC layout is not touched,
- the hardware of the consoles is essentially the same. Some minor modifications are requested in the software driving the interactive devices to adapt them to the NORD-100 system (estimation ~ 2 MM).
- Expansion to add new hardware (SC controls, beam diagnostic) are easily implemented without adding new consoles.
- the used material is in the standards of the PS/CO system: a lot of hardware and software modules can be used practically without modifications. This is particularly important for certain compiled programs (e.g. Equipment modules) that can dramatically improve the performances of the system.

It is clear that such a configuration requires some system knowledge for minor improvements and maintenance purposes: a supervisor should be named and formed. At the present it seems difficult to obtain the required personnel resources; this proposition is then valid for a possible second phase of ISOLDE 3 improvement and, may be, for the SC controls.

3- HARDWARE LAYOUT

3.1 Vacuum System

3.1.1 System description

The vacuum system is composed of a certain number of sectors separated by valves. Each sector contains: a backing pump for low vacuum and one or more turbomolecular pumps for the high vacuum.

Pressure measurements are done using two separate systems:

- Pirani gauges for values up to 10^{-5} bars,
- Penning gauges for high vacuum.

There is one Pirani and one Penning measurement per sector.

The vacuum system has been divided in seven separate sectors (fig.8 and fig.18): the first four sectors are in the separator area, the other three are in the experimental area.
The number of sectors for the experimental area can be modified in the future following other dispositions of beam lines; for this reason we foresee the control for 10 separate sectors in the present layout.
Up to now only the configuration of the first four sectors (separator area) has been specified:

- sector no.1 : one backing pump + 2 turbomolecular pumps.
- sector no.2 : one backing pump + 5 turbomolecular pumps.
- sector no.3 : one backing pump + 2 turbomolecular pumps.
- sector no.4 : one backing pump + 1 turbomolecular pump.

3.1.2 Controlled parameters

The control of the vacuum system is done using the PS standard. Quad Transceiver (QT) and Digital Single Transceiver (STD) are used as control modules for individual command and acquisition of pumps and valves status.
Multiplexers (MPX) and Scanning Analog to Digital Converters (SADC) are used to read the pressure values.

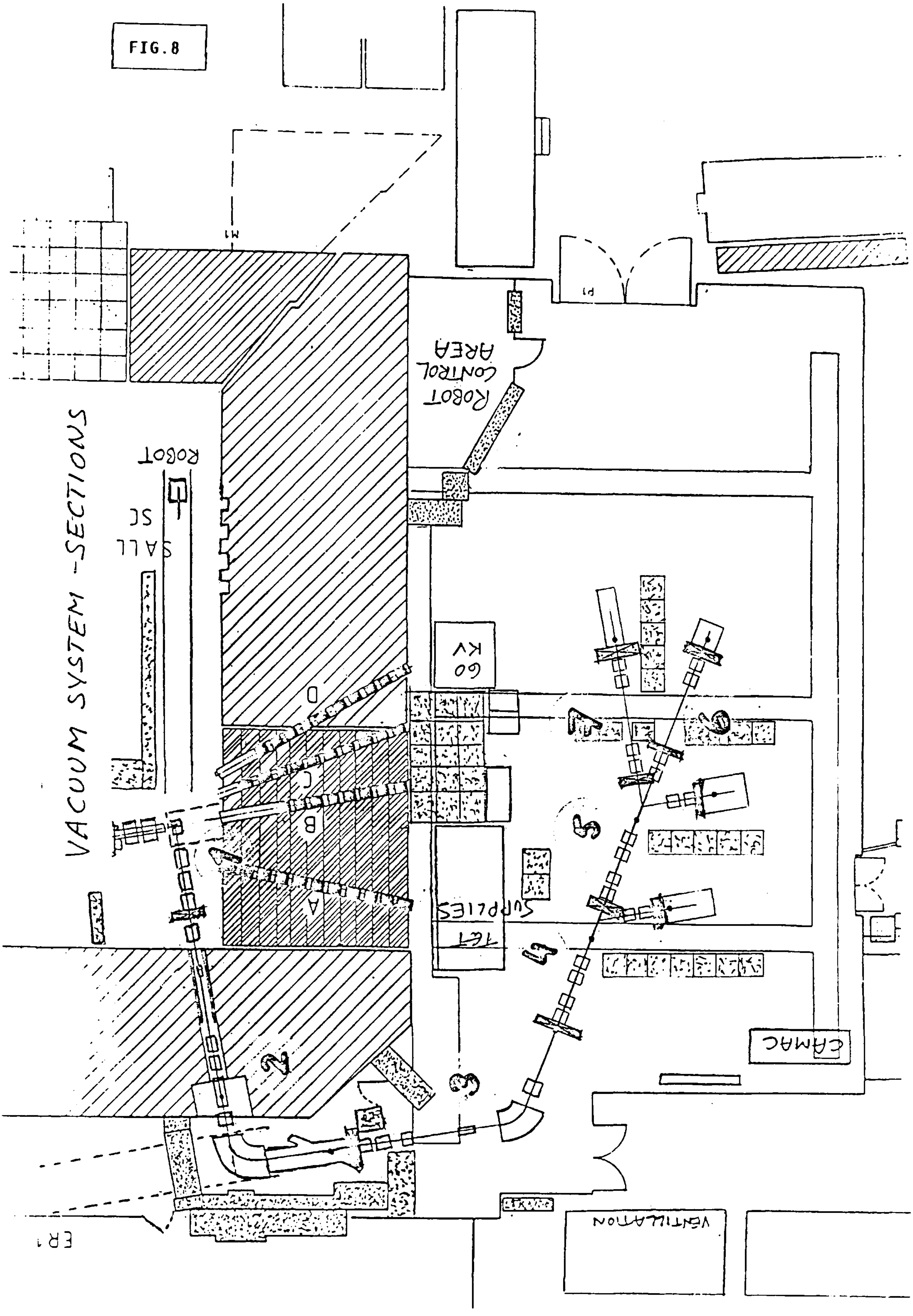
I) PUMPS

In fig.9 is represented the use of the 4 register of a STD.

A) Register A is used for control. Two bits (right justified) are allocated for each pump

- 11 undefined (no action)
- 10 pump is put ON
- 01 pump is put OFF
- 00 no action

FIG.8


VACUUM SYSTEM -SECTIONS
ROBOT
SALL SC
ROBOT CONTROL AREA
M1
P1
60 KV
TET SUPPLIES
CAMAC
VENTILATION
ER1
A
B
C
D
1
2
3
4
5
6
7

The use of two bits per element permits a setting of each pump independent of the situation of other pumps in the same STD.

B) Register B is not used.

C) Register C is used for acquisition.
Same meaning of bits as in Register A.

D) Register D is used to acquire other status informations. Three bits are allocated per pump (right justified):

- bit 1 = 0 vacuum O.K. ($< 10^{-5}$??)
- bit 2 = 0 pump under computer control (REMOTE)
- bit 3 = 0 pump status O.K.

With this bit pattern, 5 pumps at a maximum can be controlled by STD.
The exact generation of these bits will be given in a paper on the specific vacuum interface (Kugler).
Remark: The backing pump have not status information in the register D.

II) VALVES

In fig.9 is represented the use of the 4 register of the STD.

A) Register A is used for control. Two bits are allocated per valve:

- 11 undefined (no action)
- 10 valve is put OPEN
- 01 valve is put CLOSED
- 00 no action

B) Register B is not used.

C) Register C is for acquisition with the same bit specification as for Register A.

D) Register D is used for acquisition of Remote/LOCAL condition (one bit per valve).

With this bit pattern, 8 valves at a maximum can be controlled by STD.

3.1.3 Control Layout

All the standard modules for the vacuum system are grouped in the first crate of the CONSOLE 1 as shown in fig.3.

We have separated modules in two groups, one controlling the separator zone and the other controlling the experimental area. This separation will ease hardware and software maintenance. For the same

WRITE				READ
A				B
REG A1 Pump 1 ON	1 X		X 1	REG C1 Pump 1 ON
A2 Pump 1 OFF	2 X		X 2	C2 Pump 1 OFF
A3 Pump 2 ON	3 X		X 3	C3 Pump 2 ON
A4 Pump 2 OFF	4 X		X 4	C4 Pump 2 OFF
A5	5		5	C5
A6	6		6	C6
A7	7		7	C7
A8	8		8	C8
STROBE LS BYTE REG A	9		9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9	10		10	C9
A10	11		11	C10
A11	12		12	C11
A12	13		13	C12
A13	14		14	C13
A14	15		15	C14
A15 Section 1 ON	16 X		X 16	C15 Section 1 ON
A16 Section 1 OFF	17 X		X 17	C16 Section 1 OFF
STROBE MS BYTE REG A	18		18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19		19	MODE REGISTER C
OV (DIGITAL BOARD)	20		20	ENABLE DELAY - C
	21		21	
STROBE REG B	22		22	STROBE REG D
REG B1	23		X 23	REG D1 Vac not OK
B2	24		X 24	D2 Local
B3	25		X 25	D3 Pump 1 status not OK
B4	26		X 26	D4 Vac not OK
B5	27		X 27	D5 Local
B6	28		X 28	D6 Pump 2 status not OK
B7	29		29	D7
B8	30		30	D8
B9	31		31	D9
B10	32		32	D10
B11	33		33	D11
B12	34		34	D12
B13	35		35	D13
B14	36		36	D14
B15	37		37	D15
B16	38		38	D16
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39		39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40		40	MODE REGISTER D
	41		41	ENABLE DELAY - D
OV (DIGITAL BOARD)	42		42	OV (DIGITAL BOARD)
	43		43	

Console : 1

Loop : 1 Crate : 1 Slot : 3 Channel : 1

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS. 80303 CC	Isolde 3 controls Vacuum (Pumps) Separator zone section 1	figure 9. 1

WRITE						READ
A						B
REG A1 Pump 3 ON	1	X		X	1	REG C1 Pump 3 ON
A2 Pump 3 OFF	2	X		X	2	C2 Pump 3 OFF
A3 Pump 4 ON	3	X		X	3	C3 Pump 4 ON
A4 Pump 4 OFF	4	X		X	4	C4 Pump 4 OFF
A5 Pump 5 ON	5	X		X	5	C5 Pump 5 ON
A6 Pump 5 OFF	6	X		X	6	C6 Pump 5 OFF
A7 Pump 6 ON	7	X		X	7	C7 Pump 6 ON
A8 Pump 6 OFF	8	X		X	8	C8 Pump 6 OFF
STROBE LS BYTE REG A	9	X		X	9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9 Pump 7 ON	10	X		X	10	C9 Pump 7 ON
A10 Pump 7 OFF	11	X		X	11	C10 Pump 7 OFF
A11	12				12	C11
A12	13				13	C12
A13	14				14	C13
A14	15				15	C14
A15 Section 2 ON	16	X		X	16	C15 Section 2 ON
A16 Section 2 OFF	17	X		X	17	C16 Section 2 OFF
STROBE MS BYTE REG A	18				18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19				19	MODE REGISTER C
OV (DIGITAL BOARD)	20				20	ENABLE DELAY - C
	21				21	
STROBE REG B	22				22	STROBE REG D
REG B1	23			X	23	REG D1 Vac not OK
B2	24			X	24	D2 Local
B3	25			X	25	D3 Pump 3 status not OK
B4	26			X	26	D4 Vac not OK
B5	27			X	27	D5 Local
B6	28			X	28	D6 Pump 4 status not OK
B7	29			X	29	D7 Vac not OK
B8	30			X	30	D8 Local
B9	31			X	31	D9 Pump 5 status not OK
B10	32			X	32	D10 Vac not OK
B11	33			X	33	D11 Local
B12	34			X	34	D12 Pump 6 status not OK
B13	35			X	35	D13 Vac not OK
B14	36			X	36	D14 Local
B15	37			X	37	D15 Pump 7 status not OK
B16	38				38	D16
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39				39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40				40	MODE REGISTER D
	41				41	ENABLE DELAY - D
OV (DIGITAL BOARD)	42				42	OV (DIGITAL BOARD)
	43				43	

Console: 1

Loop: 1 Crate: 1 Slot: 3 Channel: 2

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS 80303 CC	Isolde 3 controls Vacuum (Pumps) Separator zone section 2	figure 9. 2

WRITE			READ
A			B
REG A1 Pump 8 ON	1 X	X 1	REG C1 Pump 8 ON
A2 Pump 8 OFF	2 X	X 2	C2 Pump 8 OFF
A3 Pump 9 ON	3 X	X 3	C3 Pump 9 ON
A4 Pump 9 OFF	4 X	X 4	C4 Pump 9 OFF
A5	5	5	C5
A6	6	6	C6
A7	7	7	C7
A8	8	8	C8
STROBE LS BYTE REG A	9	9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9	10	10	C9
A10	11	11	C10
A11	12	12	C11
A12	13	13	C12
A13	14	14	C13
A14	15	15	C14
A15 Section 3 ON	16 X	X 16	C15 Section 3 ON
A16 Section 3 OFF	17 X	X 17	C16 Section 3 OFF
STROBE MS BYTE REG A	18	18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19	19	MODE REGISTER C
OV (DIGITAL BOARD)	20	20	ENABLE DELAY - C
	21	21	
STROBE REG B	22	22	STROBE REG D
REG B1	23	X 23	REG D1 Vac not OK
B2	24	X 24	D2 Local
B3	25	X 25	D3 Pump 8 status not OK
B4	26	X 26	D4 Vac not OK
B5	27	X 27	D5 Local
B6	28	X 28	D6 Pump 9 status not OK
B7	29	29	D7
B8	30	30	D8
B9	31	31	D9
B10	32	32	D10
B11	33	33	D11
B12	34	34	D12
B13	35	35	D13
B14	36	36	D14
B15	37	37	D15
B16	38	38	D16
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39	39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40	40	MODE REGISTER D
	41	41	ENABLE DELAY-D
OV (DIGITAL BOARD)	42	42	OV (DIGITAL BOARD)
	43	43	

Console: 1

Loop: 1 Crate: 1 Slot: 3 Channel: 3

TITLE Standard Interface
SINGLE TRANSCEIVER DIGITAL VERS.80303 CC

Isolde 3 controls
Vacuum (Pumps)
Separator zone section 3

figure
9.3

WRITE					READ
A					B
REG A1 Pump lo ON	1	X	X	1	REG C1 Pump lo ON
A2 Pump lo OFF	2	X	X	2	C2 Pump lo OFF
A3	3			3	C3
A4	4			4	C4
A5	5			5	C5
A6	6			6	C6
A7	7			7	C7
A8	8			8	C8
STROBE LS BYTE REG A	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9	10			10	C9
A10	11			11	C10
A11	12			12	C11
A12	13			13	C12
A13	14			14	C13
A14	15			15	C14
A15 Section 4 ON	16	X	X	16	C15 Section 4 ON
A16 Section 4 OFF	17	X	X	17	C16 Section 4 OFF
STROBE MS BYTE REG A	18			18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19			19	MODE REGISTER C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REG B	22			22	STROBE REG D
REG B1	23		X	23	REG D1 Vac not OK
B2	24		X	24	D2 Local
B3	25		X	25	D3 Pump lo status not OK
B4	26			26	D4
B5	27			27	D5
B6	28			28	D6
B7	29			29	D7
B8	30			30	D8
B9	31			31	D9
B10	32			32	D10
B11	33			33	D11
B12	34			34	D12
B13	35			35	D13
B14	36			36	D14
B15	37			37	D15
B16	38			38	D16
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39			39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40			40	MODE REGISTER D
	41			41	ENABLE DELAY - D
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console: 1

Loop: 1 Crate: 1 Slot: 3 Channel: 4

TITLE Standard Interface
SINGLE TRANSCEIVER DIGITAL VERS. 80303 CC

Isolde 3 controls
Vacuum (Pumps)
Separator zone section 4

figure
9.4

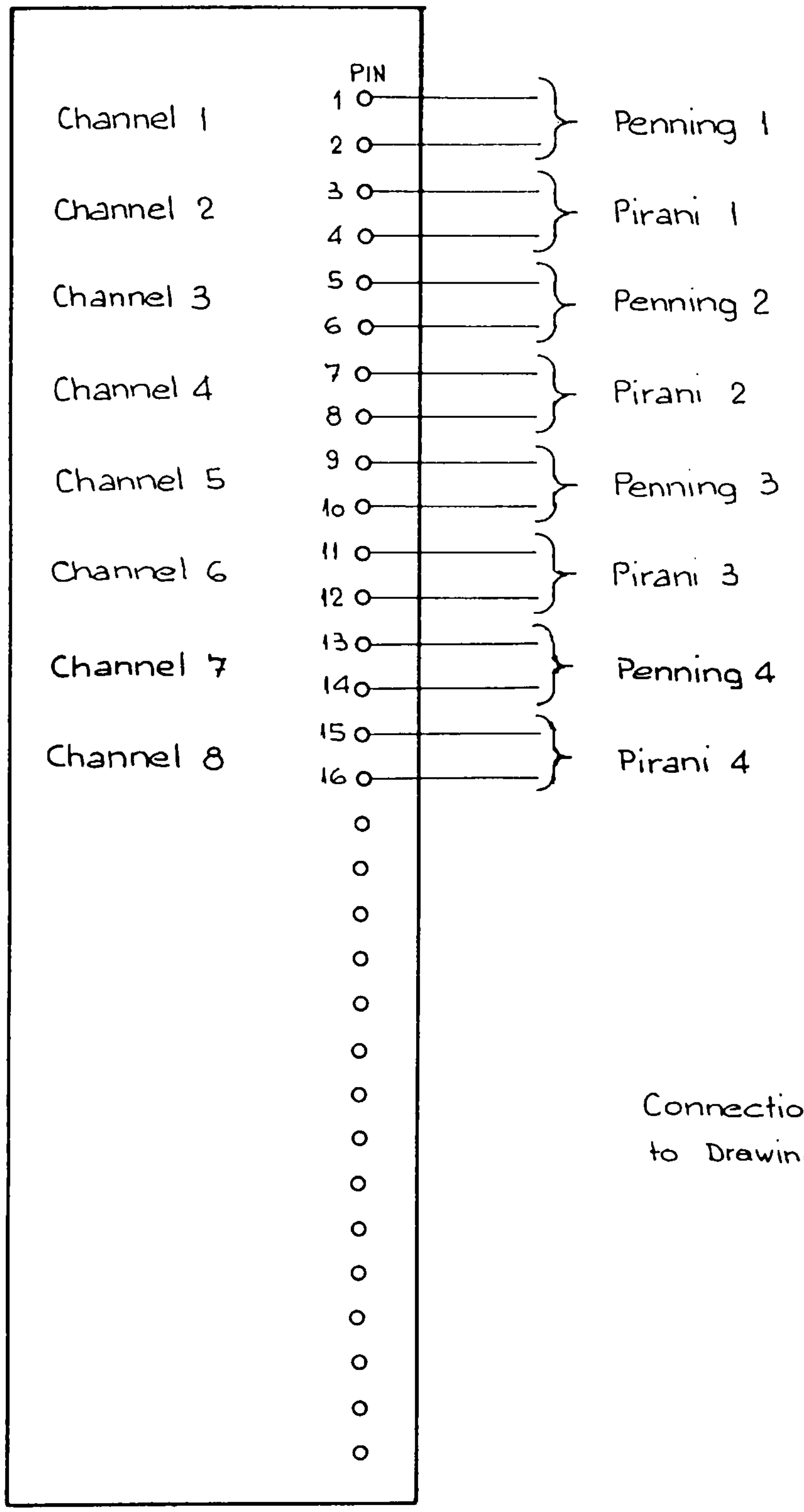
WRITE						READ
A						B
REG A1 Valve 1 open	1	X		X	1	REG C1 Valve 1 open
A2 Valve 1 close	2	X		X	2	C2 Valve 1 closed
A3 Valve 2 open	3	X		X	3	C3 Valve 2 open
A4 Valve 2 close	4	X		X	4	C4 Valve 2 closed
A5 Valve 3 open	5	X		X	5	C5 Valve 3 open
A6 Valve 3 close	6	X		X	6	C6 Valve 3 closed
A7 Valve 4 open	7	X		X	7	C7 Valve 4 open
A8 Valve 4 close	8	X		X	8	C8 Valve 4 closed
STROBE LS BYTE REG A	9				9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9 Valve 5 open	10	X		X	10	C9 Valve 5 open
A10 Valve 5 close	11	X		X	11	C10 Valve 5 closed
A11	12				12	C11
A12	13				13	C12
A13	14				14	C13
A14	15				15	C14
A15	16				16	C15
A16	17				17	C16
STROBE MS BYTE REG A	18				18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19				19	MODE REGISTER C
OV (DIGITAL BOARD)	20				20	ENABLE DELAY - C
	21				21	
STROBE REG B	22				22	STROBE REG D
REG B1	23			X	23	REG D1 Valve 1 local
B2	24			X	24	D2 Valve 2 local
B3	25			X	25	D3 Valve 3 local
B4	26			X	26	D4 Valve 4 local
B5	27			X	27	D5 Valve 5 local
B6	28				28	D6
B7	29				29	D7
B8	30				30	D8
B9	31				31	D9
B10	32				32	D10
B11	33				33	D11
B12	34				34	D12
B13	35				35	D13
B14	36				36	D14
B15	37				37	D15
B16	38				38	D16
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39				39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40				40	MODE REGISTER D
	41				41	ENABLE DELAY-D
OV (DIGITAL BOARD)	42				42	OV (DIGITAL BOARD)
	43				43	

Console: 1

Loop: 1 Crate: 1 Slot: 2 Channel: 1

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS. 80303 CC	Isolde 3 controls Vacuum (Valves) Separator zone	figure 9.5

Hughes 38 pin connector
ON frontpanel



Connection scheme according
to Drawing MPS 8 0316 CC 201

Console: 1

Loop: 1 Crate: 1 Slot: 4 Channel: 1 - 8

TITLE
Standard Interface
16 Channel Analog Multiplexer
Fokker MUX - 16/1

Isolde 3 controls
Vacuum (Measurements)
Separator zone

figure
9. 6

reasons the control of the pumps and the valves inside a sector is performed by separate Quad Transceivers.

- SEPARATOR ZONE
  One QT with one STD controls the 6 valves.
  One QT with three STD controls the 10 pumps of the zone.

  We have assigned a STD to each one of the four sectors:

- sector 1	turbo pumps 1 and 2,	+ backing pump
- sector 2	turbo pumps 3, 4, 5, 6 and 7,	+ backing pump
- sector 3	turbo pumps 8 and 9,	+ backing pump
- sector 4	turbo pump 10.	+ backing pump

  Two MPX and a SADC permit to read the 8 pressure values (4 penning values and 4 Pirani values).

- EXPERIMENTAL AREA
  One QT with one STD control 7 valves.

  Two QT with 7 STD (one per sector ??) control the pump groups. One (?) MPX and a SADC are used for pressure readings. Sufficient room is left in the CAMAC crate for future extensions.

3.2 HT inside FARADAY CAGE (60 KV)

3.2.1 System Description

The Ion source complex (power supplies and its associated electronics) is kept to a variable high potential ranging from -60 KV to +60 KV: this permits the acceleration of the generated ions. To avoid electrical interferences with the external world (discharges), all this complex is surrounded by a Faraday Cage (fig.10). The physic experiments at ISOLDE 3 require a very high stabibity of the accelerating voltage.

The HT generator is composed essentially of (See VOSICKI specifications):

- a Rough power supply,
- a Reference power supply,
- a Stabilizer.

The stabilized HT is sent to the insulated control racks inside the Faraday Cage.

3.2.2 Controlled parameters

The rough power supply and the reference one are controlled by the same STD.

The standard actuations (ON,OFF and Stand-by) control at the same time both power supplies.

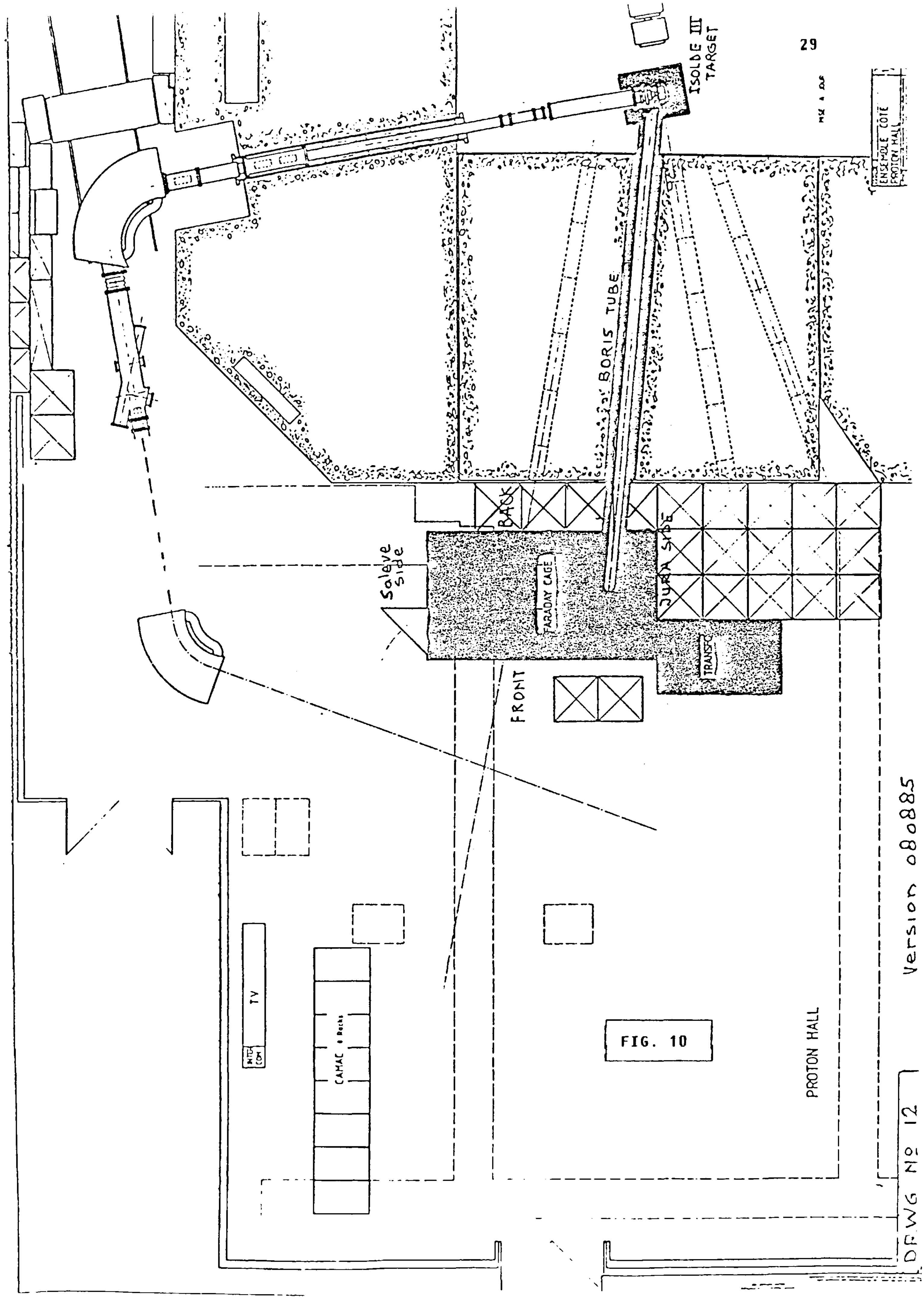


FIG. 10

Version 080885

DRWG No 12

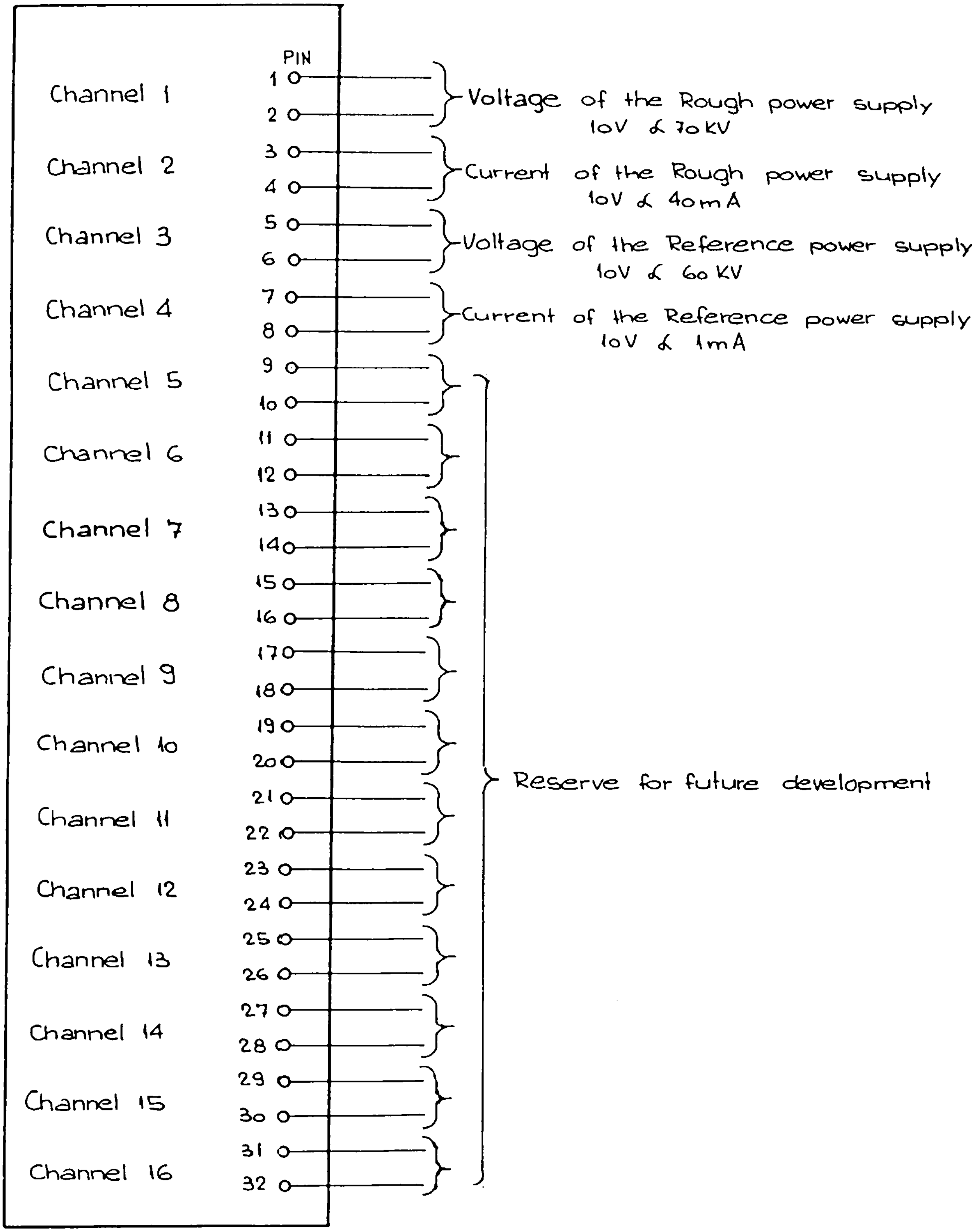
WRITE A					READ B
REG A1 OFF	1	X	X	1	REG C1 OFF
A2 Standby	2	X	X	2	C2 Standby
A3 ON	3	X	X	3	C3 ON
A4	4		X	4	C4 OK (no fault)
A5	5		X	5	C5 Up
A6	6		X	6	C6 Remote
A7	7		X	7	C7 N. Warning
A8	8		X	8	C8 Interlock
STROBE LS BYTE REG A	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9	10			10	C9
A10	11			11	C10
A11	12			12	C11
A12	13			13	C12
A13	14			14	C13
A14	15			15	C14
A15	16			16	C15
A16	17			17	C16
STROBE MS BYTE REG A	18			18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19			19	MODE REGISTER C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REG B	22			22	STROBE REG D
REG B1 LSB	23	X	X	23	REG D1 LSB
B2	24	X	X	24	D2
B3	25	X	X	25	D3
B4	26	X	X	26	D4
B5	27	X	X	27	D5
B6	28	X	X	28	D6
B7	29	X	X	29	D7
B8 16 BIT control value	30	X	X	30	D8 14 BIT acquisition value
B9	31	X	X	31	D9
B10	32	X	X	32	D10
B11	33	X	X	33	D11
B12	34	X	X	34	D12
B13	35	X	X	35	D13
B14	36	X	X	36	D14
B15	37	X		37	D15
B16 MSB	38	X	X	38	D16 Sign (1= minus)
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39			39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40			40	MODE REGISTER D
	41			41	ENABLE DELAY-D
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console: 2

Loop: 1 Crate: 1 Slot: 5 Channel: 1

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS.80303 CC	Isolde 3 controls 60 KV	figure 11.1

Hughes 38 pin connector
ON frontpanel



Console: 2

Loop: 1 Crate: 1 Slot: 10 Channel: 1 - 4

TITLE Standard Interface
16 Channel Analog Multiplexer
Fokker MUX-16/1

Isolde 3 controls
60 KV Parameters

figure
11.2

WRITE					READ
A					B
REG A1 OFF	1	X	X	1	REG C1 OFF
A2	2			2	C2
A3 ON	3	X	X	3	C3 ON
A4	4		X	4	C4 OK (no fault)
A5	5			5	C5
A6	6		X	6	C6 Remote
A7	7			7	C7
A8	8			8	C8
STROBE LS BYTE REG A	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9	10			10	C9
A10	11			11	C10
A11	12			12	C11
A12	13			13	C12
A13	14			14	C13
A14	15			15	C14
A15	16			16	C15
A16	17			17	C16
STROBE MS BYTE REG A	18			18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19			19	MODE REGISTER C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY · C
	21			21	
STROBE REG B	22			22	STROBE REG D
REG B1	23		X	23	REG D1 Auxiliary voltage 1
B2	24		X	24	D2 Auxiliary voltage 2
B3	25		X	25	D3 Assymetrie
B4	26		X	26	D4 Oil temperature
B5	27		X	27	D5 Buchholz
B6	28		X	28	D6 Faraday cage
B7	29		X	29	D7 Cooling water 1
B8	30		X	30	D8 Cooling water 2
B9	31		X	31	D9 Emercency
B10	32		X	32	D10 Compressed air
B11	33		X	33	D11 Vacuum 1
B12	34		X	34	D12 Vacuum 2
B13	35		X	35	D13 High voltage
B14	36			36	D14
B15	37			37	D15
B16	38			38	D16
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39			39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40			40	MODE REGISTER D
	41			41	ENABLE DELAY-D
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console : 2

Loop: 1 Crate: 1 Slot: 5 Channel: 2

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS 80303 CC	Isolde 3 controls Transformer	figure 12

The setting control value is sent only to the Reference power supply: the rough power supply is set by the Reference power supply.
The control value is formed of a 16 bit word without sign (sensitivity better then 10^{-5}), the acquisition has 14 bit plus a sign. Polarity is then set manually but can be read by computer. In fig. 11 are represented the 4 register of the STD with the bit meaning.

The following parameters are also acquired by computer:

- the voltage of the Rough power supply,
- the current of the Rough power supply,
- the current of the Reference power supply,
- the output voltage of the stabilizer.

The values of these parameters are adequately converted in voltages ranging from 0 to 10 V and introduced in a MPX + SADC system.

3.2.3 Control Layout

The QT and the MPX + SADC are housed in the first crate of the CONSOLE 2 as in fig. 4.

3.3 Isolation Transformer

3.3.1 System Description

As already mentionned, the nine power supplies used for the Ion source system are kept inside the Faraday Cage with a virtual hearth of about 60 KV. The mains feeding for these power supplies is produced by an oil insulated transformer located outside the Faraday cage. With a transformer ratio of 1 to 1 and a design breakdown value of 140 KV, this transformer produces the three phases required by the different power supplies.

3.3.2 Controlled Parameters

The only computer control concerns the ON/OFF command. A serie of interlock and status bits are also acquired. The control module is a STD as shown in fig. 12.

3.3.3 Control Layout

The QT is located in the first crate of the CONSOLE 2 as in fig. 4.

3.4 Target and Ion Source

3.4.1 System Description

The target and the Ion source form a compact system. Atoms of different elements are produced in a target by nuclear reaction induced by the proton beam (or He^3 beam) accelerated in the synchrocyclotron.

WRITE READ

A					B
A_1	1		X	1	C1 OFF
A_2 Standby	2	X	X	2	C2 Standby
A_3 ON	3	X	X	3	C3 ON
A_4	4		X	4	C4 OK (no fault)
A_5	5		X	5	C5 Up
A_6	6		X	6	C6 Remote
A_7	7			7	C7
A_8	8			8	C8
STROBE ACTUATION	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10		X	10	C9 I Limit
A_{10}	11			11	C10
A_{11}	12			12	C11
A_{12}	13			13	C12
A_{13}	14			14	C13
A_{14}	15			15	C14
A_{15}	16			16	C15
A_{16}	17			17	C16
STROBE TEST	18			18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19			19	MODE REGISTER - C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REFERENCE OUT	22			22	STROBE MEASURE
	23			23	
	24			24	
	25			25	
	26			26	
	27			27	
MEASURE ±5V *	28			28	
MEASURE ±2.5V *	29			29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30			30	
	31			31	
EXT REF + OUT	32			32	
EXT REF - OUT	33		X	33	DAC IN - REF +
INT REF + OUT	34	X	X	34	DAC IN - REF -
~~OV (ANALOG BOARD)~~	35	X		35	
GATE EXTERNAL REFERENCE	36			36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37			37	SHUNT POSITION
POLARITY CONTROL OUT	38			38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X	X	39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40	X	X	40	MEASURE IN - Voltage
	41			41	
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console : 2

Loop: 1 Crate : 2 Slot: 5 Channel: 1

TITLE Standard Interface
SINGLE TRANSCEIVER HYBRID VERS. 80302 CC

Isolde 3 controls
Power supply faraday cage
Electron deflector (Rack 23)

figure
13.1

WRITE READ

A						B
A_1	1			X	1	C1 OFF
A_2 Standby	2	X		X	2	C2 Standby
A_3 ON	3	X		X	3	C3 ON
A_4	4			X	4	C4 OK (no fault)
A_5	5			X	5	C5 Up
A_6	6			X	6	C6 Remote
A_7	7				7	C7
A_8	8				8	C8
STROBE ACTUATION	9				9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10			X	10	C9 I Limit
A_{10}	11				11	C10
A_{11}	12				12	C11
A_{12}	13				13	C12
A_{13}	14				14	C13
A_{14}	15				15	C14
A_{15}	16				16	C15
A_{16}	17				17	C16
STROBE TEST	18				18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19				19	MODE REGISTER - C
OV (DIGITAL BOARD)	20				20	ENABLE DELAY - C
	21				21	
STROBE REFERENCE OUT	22				22	STROBE MEASURE
	23				23	
	24				24	
	25				25	
	26				26	
	27				27	
MEASURE ±5V *	28				28	
MEASURE ±2.5V *	29				29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30				30	
	31				31	
EXT REF + OUT	32				32	
EXT REF - OUT	33			X	33	DAC IN - REF +
INT REF + OUT	34	X		X	34	DAC IN - REF −
~~OV (ANALOG BOARD)~~	35	X			35	
GATE EXTERNAL REFERENCE	36				36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37				37	SHUNT POSITION
POLARITY CONTROL OUT	38				38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X		X	39	MEASURE IN+ Acquisition
OV (ANALOG BOARD) Voltage	40	X		X	40	MEASURE IN - Voltage
	41				41	
OV (DIGITAL BOARD)	42				42	OV (DIGITAL BOARD)
	43				43	

Console : 2

Loop : 1 Crate : 2 Slot : 5 Channel : 2

TITLE Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls Power supply faraday cage Anode 1 (Rack 24)	figure 13 2

WRITE READ

A					B
A_1	1		X	1	C1 OFF
A_2 Standby	2	X	X	2	C2 Standby
A_3 ON	3	X	X	3	C3 ON
A_4	4		X	4	C4 OK (no fault)
A_5	5		X	5	C5 Up
A_6	6		X	6	C6 Remote
A_7	7			7	C7
A_8	8			8	C8
STROBE ACTUATION	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10		X	10	C9 I Limit
A_{10}	11			11	C10
A_{11}	12			12	C11
A_{12}	13			13	C12
A_{13}	14			14	C13
A_{14}	15			15	C14
A_{15}	16			16	C15
A_{16}	17			17	C16
STROBE TEST	18			18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19			19	MODE REGISTER - C
0V (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REFERENCE OUT	22			22	STROBE MEASURE
	23			23	
	24			24	
	25			25	
	26			26	
	27			27	
MEASURE ±5V *	28			28	
MEASURE ±2.5V *	29			29	0V (ANALOG BOARD)
MEASURE ± 1V * *	30			30	
	31			31	
EXT REF + OUT	32			32	
EXT REF - OUT	33		X	33	DAC IN - REF +
INT REF + OUT	34	X	X	34	DAC IN - REF -
0V ~~(ANALOG BOARD)~~	35	X		35	
GATE EXTERNAL REFERENCE	36			36	COM (0V) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37			37	SHUNT POSITION
POLARITY CONTROL OUT	38			38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X	X	39	MEASURE IN + Acquisition
0V (ANALOG BOARD) Voltage	40	X	X	40	MEASURE IN - Voltage
	41			41	
0V (DIGITAL BOARD)	42			42	0V (DIGITAL BOARD)
	43			43	

Console : 2

Loop: 1 Crate: 2 Slot: 5 Channel: 3

TITLE Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls Power supply faraday cage	figure 13.3

WRITE				READ
A				B
A1	1		X 1	C1
A2 Standby	2 X		X 2	C2 Standby
A3 ON	3 X		X 3	C3 ON
A4	4		X 4	C4 OK (no fault)
A5	5		X 5	C5 Up
A6	6		X 6	·C6 Remote
A7	7		7	C7
A8	8		8	C8
STROBE ACTUATION	9		9	EXT IN COMPARATOR SUPPLY VOLTAGE
A9	10		X 10	C9 I Limit
A10	11		11	C10
A11	12		12	C11
A12	13		13	C12
A13	14		14	C13
A14	15		15	C14
A15	16		16	C15
A16	17		17	C16
STROBE TEST	18		18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19		19	MODE REGISTER - C
OV (DIGITAL BOARD)	20		20	ENABLE DELAY - C
	21		21	
STROBE REFERENCE OUT	22		22	STROBE MEASURE
	23		23	
	24		24	
	25		25	
	26		26	
	27		27	
MEASURE ±5V *	28		28	
MEASURE ±2.5V *	29		29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30		30	
	31		31	
EXT REF + OUT	32		32	
EXT REF - OUT	33		X 33	DAC IN - REF +
INT REF + OUT	34 X		X 34	DAC IN - REF -
~~OV (ANALOG BOARD)~~	35 X		35	
GATE EXTERNAL REFERENCE	36		36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37		37	SHUNT POSITION
POLARITY CONTROL OUT	38		38	POLARITY INVERTER IN
REFERENCE OUT Control	39 X		X 39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40 X		X 40	MEASURE IN - Voltage
	41		41	
OV (DIGITAL BOARD)	42		42	OV (DIGITAL BOARD)
	43		43	

Console: 2

Loop: 1 Crate: 2 Slot: 5 Channel: 4

TITLE Standard Interface
SINGLE TRANSCEIVER HYBRID VERS.80302 CC

Isolde 3 controls
Power supply faraday cage

figure
13 4

WRITE						READ
A						B
A_1	1			X	1	C1 OFF
A_2 Standby	2	X		X	2	C2 Standby
A_3 ON	3	X		X	3	C3 ON
A_4	4			X	4	C4 OK (no fault)
A_5	5			X	5	C5 Up
A_6	6			X	6	C6 Remote
A_7	7				7	C7
A_8	8				8	C8
STROBE ACTUATION	9				9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10			X	10	C9 I Limit
A_{10}	11			X	11	C10 Temp. limit
A_{11}	12				12	C11
A_{12}	13				13	C12
A_{13}	14				14	C13
A_{14}	15				15	C14
A_{15}	16				16	C15
A_{16}	17				17	C16
STROBE TEST	18				18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19				19	MODE REGISTER - C
0V (DIGITAL BOARD)	20				20	ENABLE DELAY - C
	21				21	
STROBE REFERENCE OUT	22				22	STROBE MEASURE
	23				23	
	24				24	
	25				25	
	26				26	
	27				27	
MEASURE ±5V *	28				28	
MEASURE ±2.5V *	29				29	0V (ANALOG BOARD)
MEASURE ± 1V * *	30				30	
	31				31	
EXT REF + OUT	32				32	
EXT REF - OUT	33			X	33	DAC IN - REF +
INT REF + OUT	34	X		X	34	DAC IN - REF -
~~0V (ANALOG BOARD)~~	~~35~~	X			35	
GATE EXTERNAL REFERENCE	36				36	COM (0V) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37				37	SHUNT POSITION
POLARITY CONTROL OUT	38				38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X		X	39	MEASURE IN + Acquisition
0V (ANALOG BOARD) Voltage	40	X		X	40	MEASURE IN - Voltage
	41				41	
0V (DIGITAL BOARD)	42				42	0V (DIGITAL BOARD)
	43				43	

Console : 2

Loop : 1 Crate : 2 Slot : 6 Channel : 1

TITLE Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls Power supply faraday cage Oven heating (Rack 21)	figure 13.5

WRITE READ

A			B
A_1	1	X 1	C1 OFF
A_2 Standby	2 X	X 2	C2 Standby
A_3 ON	3 X	X 3	C3 ON
A_4	4	X 4	C4 OK (no fault)
A_5	5	X 5	C5 Up
A_6	6	X 6	C6 Remote
A_7	7	7	C7
A_8	8	8	C8
STROBE ACTUATION	9	9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10	X 10	C9 I Limit
A_{10}	11	X 11	C10 Temp. limit
A_{11}	12	12	C11
A_{12}	13	13	C12
A_{13}	14	14	C13
A_{14}	15	15	C14
A_{15}	16	16	C15
A_{16}	17	17	C16
STROBE TEST	18	18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19	19	MODE REGISTER - C
OV (DIGITAL BOARD)	20	20	ENABLE DELAY - C
	21	21	
STROBE REFERENCE OUT	22	22	STROBE MEASURE
	23	23	
	24	24	
	25	25	
	26	26	
	27	27	
MEASURE ±5V *	28	28	
MEASURE ±2.5V *	29	29	OV (ANALOG BOARD)
MEASURE ± 1V **	30	30	
	31	31	
EXT REF + OUT	32	32	
EXT REF - OUT	33	X 33	DAC IN - REF +
INT REF + OUT	34 X	X 34	DAC IN - REF -
~~OV (ANALOG BOARD)~~	35 X	35	
GATE EXTERNAL REFERENCE	36	36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37	37	SHUNT POSITION
POLARITY CONTROL OUT	38	38	POLARITY INVERTER IN
REFERENCE OUT Control	39 X	X 39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40 X	X 40	MEASURE IN - Voltage
	41	41	
OV (DIGITAL BOARD)	42	42	OV (DIGITAL BOARD)
	43	43	

Console: 2

Loop: 1 Crate: 2 Slot: 6 Channel: 2

TITLE		figure
Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls Power supply faraday cage	13.6

WRITE					READ
A					B
A_1	1		X	1	C1 OFF
A_2 Standby	2	X	X	2	C2 Standby
A_3 ON	3	X	X	3	C3 ON
A_4	4		X	4	C4 OK (no fault)
A_5	5		X	5	C5 Up
A_6	6		X	6	C6 Remote
A_7	7			7	C7
A_8	8			8	C8
STROBE ACTUATION	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10		X	10	C9 I Limit
A_{10}	11		X	11	C10 Temp. limit
A_{11}	12			12	C11
A_{12}	13			13	C12
A_{13}	14			14	C13
A_{14}	15			15	C14
A_{15}	16			16	C15
A_{16}	17			17	C16
STROBE TEST	18			18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19			19	MODE REGISTER - C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REFERENCE OUT	22			22	STROBE MEASURE
	23			23	
	24			24	
	25			25	
	26			26	
	27			27	
MEASURE ±5V *	28			28	
MEASURE ±2.5V *	29			29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30			30	
	31			31	
EXT REF + OUT	32			32	
EXT REF - OUT	33		X	33	DAC IN - REF +
INT REF + OUT	34	X	X	34	DAC IN - REF −
~~OV (ANALOG BOARD)~~	35	X		35	
GATE EXTERNAL REFERENCE	36			36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37			37	SHUNT POSITION
POLARITY CONTROL OUT	38			38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X	X	39	MEASURE IN+ Acquisition
OV (ANALOG BOARD) Voltage	40	X	X	40	MEASURE IN- Voltage
	41			41	
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console: 2

Loop: 1 Crate: 2 Slot: 6 Channel: 3

TITLE Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls Power supply faraday cage	figure 13.7

WRITE A					READ B
A_1	1		X	1	C1 OFF
A_2 Standby	2	X	X	2	C2 Standby
A_3 ON	3	X	X	3	C3 ON
A_4	4		X	4	C4 OK (no fault) *
A_5	5		X	5	C5 Up
A_6	6		X	6	C6 Remote
A_7	7			7	C7
A_8	8			8	C8
STROBE ACTUATION	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10		X	10	C9 I Limit
A_{10}	11		X	11	C10 Temp. limit
A_{11}	12			12	C11
A_{12}	13			13	C12
A_{13}	14			14	C13
A_{14}	15			15	C14
A_{15}	16			16	C15
A_{16}	17			17	C16
STROBE TEST	18			18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19			19	MODE REGISTER - C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REFERENCE OUT	22			22	STROBE MEASURE
	23			23	
	24			24	
	25			25	
	26			26	
	27			27	
MEASURE ±5V *	28			28	
MEASURE ±2.5V *	29			29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30			30	
	31			31	
EXT REF + OUT	32			32	
EXT REF - OUT	33		X	33	DAC IN - REF +
INT REF + OUT	34	X	X	34	DAC IN - REF -
OV ~~(ANALOG BOARD)~~	35	X		35	
GATE EXTERNAL REFERENCE	36			36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37			37	SHUNT POSITION
POLARITY CONTROL OUT	38			38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X	X	39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40	X	X	40	MEASURE IN - Voltage
	41			41	
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

* bit 4 = 0 in case of phase error.

Console : 2

Loop: 1 Crate: 2 Slot: 7 Channel: 1

TITLE Standard Interface SINGLE TRANSCEVER HYSRID VERS. 80302 CC	Isolde 3 controls Power supply faraday cage	figure 13.8

WRITE				READ
A				B
A_1	1		X 1	C1 OFF
A_2 Standby	2 X		X 2	C2 Standby
A_3 ON	3 X		X 3	C3 ON
A_4	4		X 4	C4 OK (no fault) *
A_5	5		X 5	C5 Up
A_6	6		X 6	C6 Remote
A_7	7		7	C7
A_8	8		8	C8
STROBE ACTUATION	9		9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10		X 10	C9 I Limit
A_{10}	11		X 11	C10 Temp. limit
A_{11}	12		12	C11
A_{12}	13		13	C12
A_{13}	14		14	C13
A_{14}	15		15	C14
A_{15}	16		16	C15
A_{16}	17		17	C16
STROBE TEST	18		18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19		19	MODE REGISTER - C
0V (DIGITAL BOARD)	20		20	ENABLE DELAY - C
	21		21	
STROBE REFERENCE OUT	22		22	STROBE MEASURE
	23		23	
	24		24	
	25		25	
	26		26	
	27		27	
MEASURE ±5V *	28		28	
MEASURE ±2.5V *	29		29	0V (ANALOG BOARD)
MEASURE ±1V * *	30		30	
	31		31	
EXT REF + OUT	32		32	
EXT REF - OUT	33		X 33	DAC IN - REF +
INT REF + OUT	34 X		X 34	DAC IN - REF −
~~0V (ANALOG BOARD)~~	35 X		35	
GATE EXTERNAL REFERENCE	36		36	COM (0V) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37		37	SHUNT POSITION
POLARITY CONTROL OUT	38		38	POLARITY INVERTER IN
REFERENCE OUT Control	39 X		X 39	MEASURE IN+ Acquisition
0V (ANALOG BOARD) Voltage	40 X		X 40	MEASURE IN- Voltage
	41		41	
0V (DIGITAL BOARD)	42		42	0V (DIGITAL BOARD)
	43		43	

* bit 4 = 0 in case of phase error

Console : 2

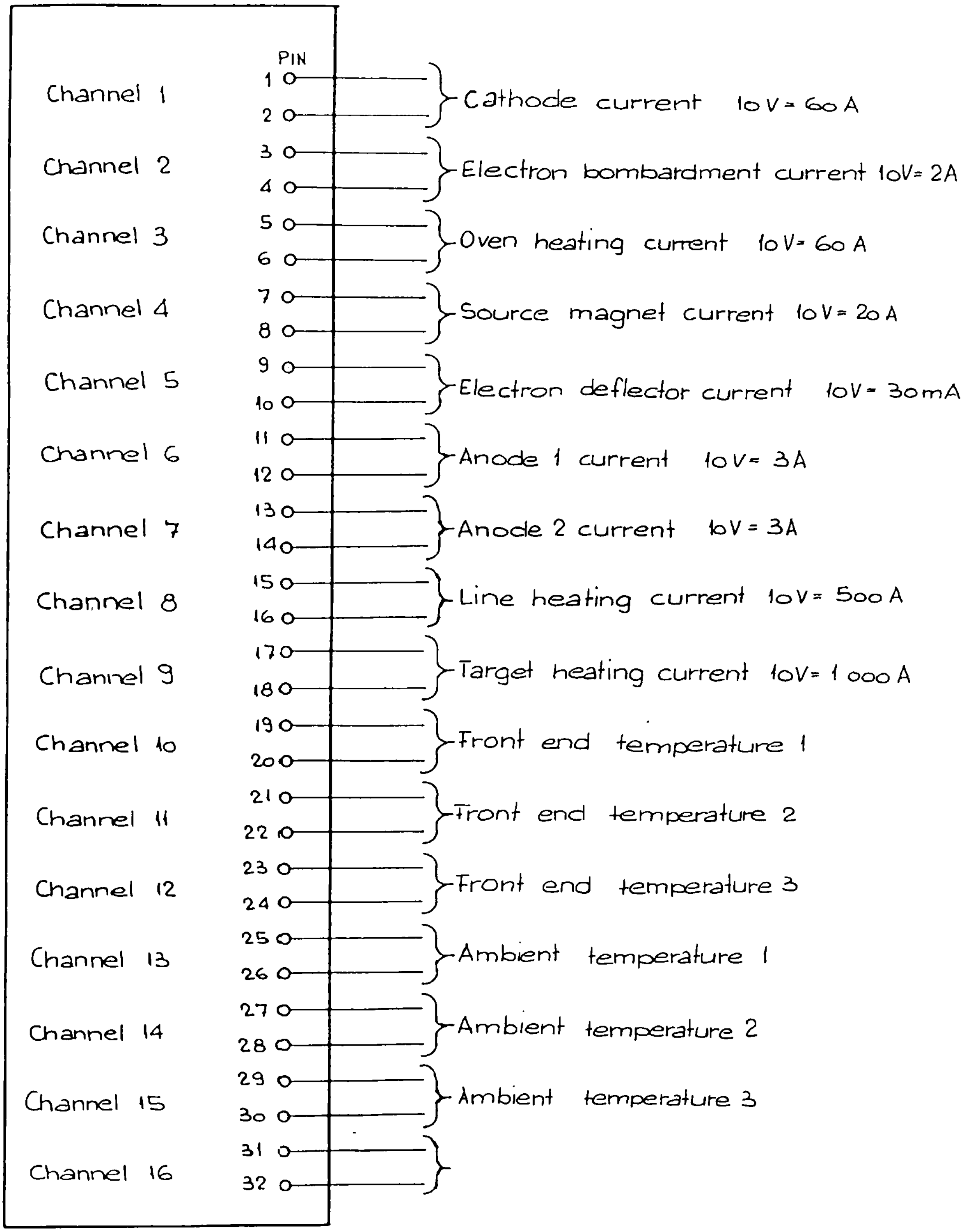
Loop: 1 Crate: 2 Slot: 7 Channel: 2

TITLE Standard Interface
SINGLE TRANSCEIVER HYBRID VERS. 80302 CC

Isolde 3 controls
Power supply faraday cage
Target heating (Pack 23)

figure
13.9

Hughes 38 pin connector
ON frontpanel



Console: 2

Loop: 1 Crate: 2 Slot: 10 Channel: 1 - 15

TITLE		figure
Standard Interface *16 Channel Analog Multiplexer* *Fokker MUX - 16/1*	Isolde 3 controls Faraday cage Measurements	13.10

Adequate heating procedures permit these atoms to migrate from the target, through the Transfer line, to the ion source. The produced atoms are ionized by an ion source.

Several types of ion sources are foreseen, each one requiring the use of a certain number of power supplies. Nine power supplies are installed in total but only a part of them is used for each configuration.

The nine power supplies are:

1) Electron deflector	(3 KV)
2) Anode 1	(3 A)
3) Anode 2	(3 A)
4) Electron bombardement	(2 A)
5) Oven Heating	(60 A)
6) Cathode	(60 A)
7) Source Magnet	(3 A)
8) Line Heating	(500 A)
9) Target Heating	(1000 A)

Before the start of a run with a new configuration, the specialists will manually connect (using a patch-panel) the concerned power supplies to the selected devices.

3.4.2 Controlled Parameters

The nine power supplies are controlled by Hybrid Single Transceivers (STH). Twelve bits without sign are used for command and acquisition.

- control voltages	0 -10V	12 bits, no sign
- acquisition voltages	0 -10V	12 bits, no sign

Actuation bits are as ususal ON] Control and acquisition
STAND-BY]
OFF Acquisition only

Faults and other status bits are also provided. Fig. 13 gives the position and the meaning of the bits in the different Single Transceiver registers.

During operation with power supplies, the current delivered for a given voltage can change because the value of the charge (R) changes with the temperature.

The acquisition of this current is not possible with the same STH because there is only one analog input. The nine currents are then converted in adequately scaled voltages and are digitized using a Standard MPX + SADC system.

A certain number of temperature measurements are also necessary in the ion source area (high temperature) and in the Faraday Cage area (Low temperature).

Six measurement channels have been provided:

- T1 at the Target,
- T2 at ions source,
- T3 Reserved for ion source zone,
- T4 Faraday cage air,
- T5 Faraday cage cooling water,
- T6 Reserved for Faraday cage zone.

The different kind of used thermocouples produces voltages ranging from 0 to 50 mV for the measured temperatures: these values are adequataly amplified (0 - 10V) and are measured using a standard MPX-SADC system.

3.4.3 Hardware Layout

The control modules are grouped in the CAMAC crate no.1 of the CONSOLE 2 as shown in Fig.4.

Three Quad Transceivers control the 9 power supplies.
The 16 input channels of the Multiplexer receive the 9 currents and the 6 temperature values.
As already mentionned the CAMAC crate is housed inside the Faraday cage: as all the other equipment, it is then at a virtual earth potential of 60 KV. The connection with the CAMAC Loop is realised by an optical fiber link.

3.5 Beam Transport

3.5.1 System Description

The Ions produced in the source are guided along about 25 m of Vacuum chamber up to the various experiments in the proton hall. During their travel Ions are focused by quadrupoles, steered by dipoles and bended toward user lines by deflectors.
All the elements of the beam transport are of the electrostatic type: this allows actions on the Ions independent of their masses.

A) Quadrupoles:

Quadrupoles are grouped in sets of 1 (singlet), 2 (doublet) or 3 (triplet). Each group of quadrupoles, singlets, doublets or triplets, owns a couple of guard rings, one at each side of the group: they compensate for the fringe field of the quadrupoles.

There are nine quadrudoles for the separator.

- 2 singlets,
- 2 doublets,
- 1 triplet.

In the experimental area, there are 28 quadrupoles grouped in 14 doublets.

B) Dipoles (X-Y plates)

These elements permit correction of the Ions trajectory in the horizontal and vertical plane (steering). Each set is composed of a couple of horizontal and a couple of vertical plate to which adequate potential is applied. The feeding for each couple of plates is composed of two power supplies: a fixed one (-1000V) common to all dipoles, and a variable one (from 0 to +2000V) specific to each element.
The combined effect of these two power supplies produces a variable voltage across the plates ranging from -1000V to +1000V.
Three X-plates and three Y-plates are installed in the separator beam path. Another 6 X-plates and 6 Y-plates are installed in the experimental areas. Guard Rings are provided at the two ends of each couple of plates as in A. Guard Rings need a fixed voltage value: this voltage is obtained using adequate attenuators on the common -1000V power supply.

C) Deflectors (Benders)

There are two deflectors in the experimental area: they permit to bend the Ions beam and to bring it to the different users. Each deflector is composed of a couple of curved plates where adequate voltage is applied. Guard Rings are also provided at the two ends of each deflector as in A.
Two power supplies per deflector are installed, one per each plate. The Guard Rings are connected using an attenuator on the common -1000V power supply as for the dipoles.

3.5.2 Controlled parameters

All the power supplies for the beam transport are controlled using Hybrid Single Transceivers (STH).

The command for the actuation (ON/OFF) is manual and individual; only the acquisition of the actuations is possible by computer. The setting control value word is composed of 12 bits without sign. The acquisition word has 12 bits plus the sign bit. The C register of the single transceiver contains a certain number of status bits; the meaning and position of these bits are slightly different for the quadrupoles and for the dipoles. All these informations are summerized in Fig.14.

3.5.3 Hardware Layout

The Quad Transceivers for the beam transport control are housed in two separate CAMAC crates of CONSOLE 3 (See Fig.5).

A) The first CAMAC crate for the separator zone contains:

- two Quad Transceiver (6 STH) for the dipoles,
- three Quad Transceiver (9 STH) for the quadrupoles.

B) The second CAMAC crate for the experimental area contains:

- seven Quad Transceiver (28 STH) for the quadrupoles,
- three Quad Transceiver (12 STH) for the dipoles,
- one Quad Transceiver (2 STH) for the bendings.

3.6 Extraction Electrode Movements

3.6.1 System description

The initial direction of the Ion beam is adjusted using an appropriate extraction electrode system.
The extraction tube is mounted on a hydraulic mechanism permitting three degrees of freedom: one longitudinal movement along the Z axe and two tilts around the X and Y axes. The longitudinal movement allows a maximum displacement of 150 mm and requires a resolution of a tenth of mm. The two tilt movements allow a maximum angular rotation of 3 degrees: the corresponding maximum displacement of the edge of the electrode is of 4 mm and the required resolution is of 1/100 of mm.
Three separate D.C. motors provide for the three movements.

3.6.2 Controlled parameters

The three D.C. motors are controlled using three separate Hybrid Single Transceivers (STH).

Twelve bits without sign are used in command and in acquisition.

The produced voltage ranges between 0 and 10 volts:

- zero volt means an initial start position for the longitudinal movement and a maximum negative angle (-3 degrees) for the two tilts.

- 10 volt means a maximum displacement (+150mm) for the longitudinal movement and a maximum angle (+3 degrees) for the two tilts.

The actuations (ON/OFF) exists for all the three motors but they are in common: this means a command on any of the three motors acts on all of them. Some status bits are also provided (see fig. 15): they are the end switches.

Remark: The control value sent to the STH corresponds to the absolute value of the positions required on each one of the three shafts (no incremental mode is used).

WRITE A			READ B
A_1	1	X 1	C1 OFF
A_2	2	2	C2
A_3	3	X 3	C3 ON
A_4	4	X 4	C4 OK (no fault)
A_5	5	X 5	C5 Up
A_6	6	X 6	C6 Remote
A_7	7	X 7	C7 N. Warning
A_8	8	X 8	C8 Interlock
STROBE ACTUATION	9	9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10	X 10	C9 I Limit pos.
A_{10}	11	X 11	C10 I Limit neg.
A_{11}	12	X 12	C11 I Limit guard rings
A_{12}	13	13	C12
A_{13}	14	14	C13
A_{14}	15	15	C14
A_{15}	16	16	C15
A_{16}	17	17	C16
STROBE TEST	18	18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19	19	MODE REGISTER - C
OV (DIGITAL BOARD)	20	20	ENABLE DELAY - C
	21	21	
STROBE REFERENCE OUT	22	22	STROBE MEASURE
	23	23	
	24	24	
	25	25	
	26	26	
	27	27	
MEASURE ±5V *	28	28	
MEASURE ±2.5V *	29	29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30	30	
	31	31	
EXT REF + OUT	32	32	
EXT REF - OUT	33	X 33	DAC IN - REF +
INT REF + OUT	34 X	X 34	DAC IN - REF −
OV (ANALOG BOARD)	35 X	35	
GATE EXTERNAL REFERENCE	36	36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37	37	SHUNT POSITION
POLARITY CONTROL OUT	38	38	POLARITY INVERTER IN
REFERENCE OUT Control	39 X	X 39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40 X	X 40	MEASURE IN - Voltage
	41	41	
OV (DIGITAL BOARD)	42	42	OV (DIGITAL BOARD)
	43	43	

Console : 3

Loop: 1 Crate: 1 Slot: 12/13/14 Channel: 1-4/1-4/1

TITLE Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls HV Power supplies for quadrupoles	figure 14. 1

WRITE					READ
A					B
A_1	1		X	1	C1 OFF
A_2	2			2	C2
A_3	3		X	3	C3 ON
A_4	4		X	4	C4 OK (no fault)
A_5	5		X	5	C5 Up
A_6	6		X	6	C6 Remote
A_7	7		X	7	C7 N. Warning
A_8	8		X	8	C8 Interlock
STROBE ACTUATION	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE
A_9	10		X	10	C9 Overcurrent
A_{10}	11		X	11	C10 System check
A_{11}	12			12	C11
A_{12}	13			13	C12
A_{13}	14			14	C13
A_{14}	15			15	C14
A_{15}	16			16	C15
A_{16}	17			17	C16
STROBE TEST	18			18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19			19	MODE REGISTER - C
0V (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REFERENCE OUT	22			22	STROBE MEASURE
	23			23	
	24			24	
	25			25	
	26			26	
	27			27	
MEASURE ±5V *	28			28	
MEASURE ±2.5V *	29			29	0V (ANALOG BOARD)
MEASURE ± 1V * *	30			30	
	31			31	
EXT REF + OUT	32	X		32	
EXT REF - OUT	33	X	X	33	DAC IN - REF +
INT REF + OUT	34		X	34	DAC IN - REF -
~~0V (ANALOG BOARD)~~	~~35~~			~~35~~	
GATE EXTERNAL REFERENCE	36			36	COM (0V) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37			37	SHUNT POSITION
POLARITY CONTROL OUT	38			38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X	X	39	MEASURE IN + Acquisition
0V (ANALOG BOARD) Voltage	40	X	X	40	MEASURE IN - Voltage
	41			41	
0V (DIGITAL BOARD)	42			42	0V (DIGITAL BOARD)
	43			43	

Console: 3

Loop: 1 Crate: 1 Slot: 9/10 Channel: 1-4/1-2

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS 80303 CC	Isolde 3 controls HV Power supplies for X-Y Plates	figure 14. 2

WRITE A				READ B
A1	1		X 1	C1 OFF
A2	2		2	C2
A3	3		X 3	C3 ON
A4	4		X 4	C4 OK (no fault)
A5	5		5	C5
A6	6		6	C6
A7	7		7	C7
A8	8		8	C8
STROBE ACTUATION	9		9	EXT IN COMPARATOR SUPPLY VOLTAGE
A9	10		10	C9
A10	11		11	C10
A11	12		12	C11
A12	13		13	C12
A13	14		14	C13
A14	15		15	C14
A15	16		16	C15
A16	17		17	C16
STROBE TEST	18		18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19		19	MODE REGISTER - C
OV (DIGITAL BOARD)	20		20	ENABLE DELAY - C
	21		21	
STROBE REFERENCE OUT	22		22	STROBE MEASURE
	23		23	
	24		24	
	25		25	
	26		26	
	27		27	
MEASURE ±5V *	28		28	
MEASURE ±2.5V *	29		29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30		30	
	31		31	
EXT REF + OUT	32		32	
EXT REF - OUT	33		X 33	DAC IN - REF +
INT REF + OUT	34 X		X 34	DAC IN - REF -
OV (ANALOG BOARD)	35 X		35	
GATE EXTERNAL REFERENCE	36		36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37		37	SHUNT POSITION
POLARITY CONTROL OUT	38		38	POLARITY INVERTER IN
REFERENCE OUT Control *	39		X 39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40		X 40	MEASURE IN - Voltage
	41		41	
OV (DIGITAL BOARD)	42		42	OV (DIGITAL BOARD)
	43		43	

* No control voltage needed

Console : 3

Loop : 1 Crate : 1 Slot : 10 Channel : 3

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS 30303 CC	Isolde 3 controls HV Power supplies for X-Y Plates Common supply	figure 14.3

3.6.3 Hardware Layout

The only used Quad Transceiver (controlling 3 STH) is housed in the separator zone CAMAC Crate of CONSOLE 3 (Fig.5).

3.7 Analysing Magnets

3.7.1 System Description

Two magnets installed in the Isolde 3 beam line (Fig.1) allow the required separation of the Ion masses.

The selection of the mass is made by the first magnet. The second magnet improves the resolution.

Mass calculation are done using the formula:

$M = K\ B^2/V$ where V is the accelerating voltage.

Measured masses are in the order of hundreds of proton mass and a precision of 0.1 mass is requested ($\sim 10^{-3}$).
This means that voltages must be measured with an accuracy of 10^{-3} and magnetic field with an accuracy of 5.10^{-4}.

Magnetic fields is usually determined by measuring the current in the magnet coils.
A more precise measurement is obtained using an Hall effect pick-up. The second method permits the mass determination with the required precision.

The intensity of the ions beam is measured using a Faraday Cup and an high precision ampermeter (10^{-9} A). The selection of the masses (current setting in the analysing magnets) is done by computer using the control console in the control room. The user can also specify mass locally by sending appropriate information to the computer (see below).

3.7.2 Controlled Parameters

The analysing magnets are controlled using a QT and two digital ST. The command word is 16 bits without sign. Acquisition word is 15 bits plus sign bit. Actuations are standard in command and acquisition. Several status information are also provided as indicated in Fig.16.

Ion current is measured using an Keithly picoampermeter connected to CAMAC via a GPIB Mod. KINETICS 2232 standard interface module. The IN/OUT of the Faraday cup is done via an I/O register (see also 3.8.2)
The connection with the Hall plate device Teslameter is done by means of RS 232 interface mod.3340.

To permit the user to select masses an I/O register is installed in the Camac crate. Masses are specified by sending to the input register (16 bits) the BCD code of the selected value. For example

WRITE | READ

A					B
A1 OFF *	1	X	X	1	C1 OFF
A2	2			2	C2
A3 ON *	3	X	X	3	C3 ON
A4	4			4	C4
A5	5			5	C5
A6	6			6	C6
A7	7			7	C7
A8	8			8	C8
STROBE ACTUATION	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE
A9	10			10	C9
A10	11			11	C10
A11	12			12	C11
A12	13			13	C12
A13	14			14	C13
A14	15			15	C14
A15	16			16	C15
A16	17			17	C16
STROBE TEST	18			18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19			19	MODE REGISTER - C
OV (DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REFERENCE OUT	22			22	STROBE MEASURE
	23			23	
	24			24	
	25			25	
	26			26	
	27			27	
MEASURE ±5V *	28			28	
MEASURE ±2.5V *	29			29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30			30	
	31			31	
EXT REF + OUT	32			32	
EXT REF - OUT	33		X	33	DAC IN - REF +
INT REF + OUT	34	X	X	34	DAC IN - REF -
OV (ANALOG BOARD)	35	X		35	
GATE EXTERNAL REFERENCE	36			36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37			37	SHUNT POSITION
POLARITY CONTROL OUT	38			38	POLARITY INVERTER IN
REFERENCE OUT Control	39	X	X	39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40	X	X	40	MEASURE IN - Voltage
	41			41	
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console : 3

Loop : 1 Crate : 1 Slot : 17 Channel : 1 Angular X - AX 15

2 Angular Y - AX 15

3 Longitudinal Z - AX 15

* For longitudinal movement only

TITLE Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls Extraction electrode movements	figure 15

WRITE A					READ B
REG A1 OFF	1	X	X	1	REG C1 OFF
A2 Standby	2	X	X	2	C2 Standby
A3 ON	3	X	X	3	C3 ON
A4 Reset	4	X	X	4	C4 OK (no fault)
A5	5		X	5	C5 Up
A6	6		X	6	C6 Remote
A7	7		X	7	C7 N. Warning
A8	8		X	8	C8 Interlock
STROBE LS BYTE REG A	9			9	EXT IN COMPARATOR SUPPLY VOLTAGE REG C
A9	10		X	10	C9 0. current rect.
A10	11		X	11	C10 W.F. rect.
A11	12		X	12	C11 Temp. rect.
A12	13		X	13	C12 Phase
A13	14		X	14	C13 Earth fault
A14	15		X	15	C14 0. current magnet
A15	16		X	16	C15 Doors
A16	17		X	17	C16 W.F magnet
STROBE MS BYTE REG A	18			18	STROBE REG C
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG A	19			19	MODE REGISTER C
OV(DIGITAL BOARD)	20			20	ENABLE DELAY - C
	21			21	
STROBE REG B	22			22	STROBE REG D
REG B1 LSB	23	X	X	23	REG D1 LSB
B2	24	X	X	24	D2
B3	25	X	X	25	D3
B4	26	X	X	26	D4
B5	27	X	X	27	D5
B6	28	X	X	28	D6
B7	29	X	X	29	D7
B8 16 BIT control value	30	X	X	30	D8 15 BIT acquisition value
B9	31	X	X	31	D9
B10	32	X	X	32	D10
B11	33	X	X	33	D11
B12	34	X	X	34	D12
B13	35	X	X	35	D13
B14	36	X	X	36	D14
B15	37	X	X	37	D15
B16 MSB	38	X	X	38	D16 Sign (1= minus)
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE REG B	39			39	EXT IN COMPARATOR SUPPLY VOLTAGE REG D
	40			40	MODE REGISTER D
	41			41	ENABLE DELAY-D
OV (DIGITAL BOARD)	42			42	OV (DIGITAL BOARD)
	43			43	

Console: 3

Loop: 1 Crate: 1 Slot: 2 Channel: 1 (90° Magnet)
2 (60° Magnet)

TITLE Standard Interface SINGLE TRANSCEIVER DIGITAL VERS. 80303 CC	Isolde 3 controls Power supplies for analysing magnets (90°+60°)	figure 16

to obtain a mass of 144,5 the user has to send the value 1445 coded in BCD. The computer will read periodically the input register and will adjust the current in the magnet appropriately.

3.7.3 Hardware Layout

The Quad Transceiver, the GPIB interface and the RS 232 module are installed in the crate no.1 of the Loop no.3 as explained in Fig.5. The I/O register is installed in the crate no.2 of the CONSOLE 3.

3.8 BEAM DIAGNOSTIC

Four types of devices are foreseen for beam disgnostics:

1) SLITS
2) FARADAY CUPS
3) WIRE GRIDS
4) WIRE SCANNERS

In the present layout only the control of the first two devices (slits and Faraday cups) are described. The other two devices are not controlled by computer for the time being.

3.8.1 SLITS

This device permits to reduce the transversal dimensions of the ion beam. It is composed of plates that are introduced in a plane perpendicular to the beam. In general each group of SLIT is composed of 2 horizontal and 2 vertical plates that can be moved separately.

There are two types of SLITS:
- fixed position SLITS that can be introduced into the beam only at a fixed position (holes in the plate).
- proportional SLITS that can be moved into the beam at any variable position.

A) Fixed position SLITS

There is only one set of these SLITS.
Only three simple commands are foreseen:
- IN,
- OUT,
- NEUTRAL, corresponding to an intermediate position.

Control is done using an I/O register type BORER 1031: acquisition of the status is also provided using the same module. The first three bits are used with the meaning:

- 001	IN
- 010	OUT
- 100	NEUTRAL.

The I/O register is housed in Crate no.3 of CONSOLE 1 as shown in fig.3. See also fig.17.

B) Proportional SLITS

There are two sets of this type of SLITS.
Each set is composed of a couple of horizontal and a couple of vertical plates.
Each plate can be moved individually.
Control and acquisition are done using Hybrid Single Transceivers (HST): twelve bits without sign corresponds to a maximum voltage of 10V sent to the motor.
Each plate has assigned an independent motor and then a HST: in total there are 8 HST connected to 2 Quad Transceivers (QT).
No ON/OFF or other status bits are foreseen.
The two QT are housed in Crate no.3 of CONSOLE 1 as shown in fig.3. See also fig.17.

3.8.2 Faraday Cups

This device permits an absolute reading of the beam current. The collected charge is measured using a sensitive electrometer (Keithly).
There are several F.C. in ISOLDE 3 experiment, some in the separator zone, other in the experiment area.

In the present layout we foresee the control of 8 F.C., but extensions are straightforward.

Only one F.C. can be controlled at a time.

The control realizes the following functions:
- putting a F.C. IN or OUT,
- connecting the selected F.C. to the electrometer (SCANNER),
- reading the electrometer.

The first function is performed using an I/O register type BORER 1031. Two exclusive bits are allocated per F.C. giving a total of 8 F.C. connected to the register.
Acquisition of the IN/OUT condition is also obtained in the same register with the same bit pattern. The other two functions are realized using a GPIB interface type KINETICS 2232.
The I/O register and the GPIB interface are housed in the Crate 3 of the CONSOLE 1 as shown in fig.3. See also fig.18.

Remark: one of the Faraday Cups exists in the system (see 3.7.1) controlled in a similar way but in CONSOLE 3: this is used in connection with the control of the analysing magnet to measure the total ion current. For this reason this F.C. must be controlled by the same console as for the Magnet.

3.9 TAPE TRANSPORT

This device permits to measure the activity of ion samples collected on a moving Tape.

WRITE			READ
A			B
A1	1	1	C1
A2	2	2	C2
A3	3	3	C3
A4	4	4	C4
A5	5	5	C5
A6	6	6	C6
A7	7	7	C7
A8	8	8	C8
STROBE ACTUATION	9	9	EXT IN COMPARATOR SUPPLY VOLTAGE
A9	10	10	C9
A10	11	11	C10
A11	12	12	C11
A12	13	13	C12
A13	14	14	C13
A14	15	15	C14
A15	16	16	C15
A16	17	17	C16
STROBE TEST	18	18	STROBE STATUS-WORD
EXT COM OPEN COLLECTOR SUPPLY VOLTAGE	19	19	MODE REGISTER - C
OV (DIGITAL BOARD)	20	20	ENABLE DELAY - C
	21	21	
STROBE REFERENCE OUT	22	22	STROBE MEASURE
	23	23	
	24	24	
	25	25	
	26	26	
	27	27	
MEASURE ±5V *	28	28	
MEASURE ±2.5V *	29	29	OV (ANALOG BOARD)
MEASURE ± 1V * *	30	30	
	31	31	
EXT REF + OUT	32	32	
EXT REF - OUT	33	X 33	DAC IN - REF +
INT REF + OUT	34 X	X 34	DAC IN - REF −
~~OV (ANALOG BOARD)~~	35 X	35	
GATE EXTERNAL REFERENCE	36	36	COM (OV) EXTERNAL REFERENCE
INVERTER CONTROL DAC	37	37	SHUNT POSITION
POLARITY CONTROL OUT	38	38	POLARITY INVERTER IN
REFERENCE OUT Control	39 X	X 39	MEASURE IN + Acquisition
OV (ANALOG BOARD) Voltage	40 X	X 40	MEASURE IN - Voltage
	41	41	
OV (DIGITAL BOARD)	42	42	OV (DIGITAL BOARD)
	43	43	

CHANNEL 1 : Left Plate
2 : Right Plate
3 : Top Plate
4 : Bottom Plate

Console: 1

Loop: 1 Crate: 3 Slot: 5+6

TITLE		figure
Standard Interface SINGLE TRANSCEIVER HYBRID VERS. 80302 CC	Isolde 3 controls SLIT MOVEMENTS	17

I/O REGISTER TYPE 1031 A

IN BITS	OUT BITS		
1	1	ID. CUP 01	IN
2	2	ID. CUP 01	OUT
3	3	ID. CUP 02	IN
4	4	ID. CUP 02	OUT
5	5	ID. CUP 03	IN
6	6	ID. CUP 03	OUT
7	7	ID. CUP 04	IN
8	8	ID. CUP 04	OUT
9	9	ID. CUP 05	IN
10	10	ID. CUP 05	OUT
ADDRESS : CONSOLE 1 L = 1 C = 3 N = 11			

FARADAY CUPS IN/OUT MOVEMENTS
SEPARATOR ZONE

fig. 18

The presented control layout is based on a first estimation of the functions needed by the measurement: it is possible that the actual implementation requires some modifications.

The following modules are used:
- five General Purpose Preset Counters (GPPC) generate 10 timing Triggers to start and to gate the different operations,
- one clock module provides the pulse trains to feed the GPPC's,
- one double UP/DOWN Counter provides counting facilities up to $2^{32} - 1$ counts for a single measurement.

These modules are housed in Crate no.2 of CONSOLE 1 as shown in fig. 3.

4- SOFTWARE LAYOUT

As already mentionned in each console there will be only a main program (TRUNK), written in Nodal, taking into account of both the global applications structure and the execution of each application itself.

Applications are organized in a hierarchical tree structure: subsequent pages on the touch screen permits the operation to select a program and to execute the appropriate action.

Separate hardware buttons permit at any moment to come back to the previous page or to the main trunk. The main program has to interrogate periodically (LOOP) many interactive devices and at the same time has to generate display, has to control parameters etc...; as a consequence the response time cannot be very short.

Nevertheless an adequate choice of software techniques permits to keep this value inside acceptable limits.

4.1 Equipment Modules (EM)

Each hardware system has a specific control protocol: this depends on the intrinsic characteristics of the system and on the standard CAMAC interface module connected to it.

The equipment module is a software package that absorbs all the intricacies of the different systems and presents to the application program a standard calling protocol.

For example, if one wants to set a control value of 10 Amps on the power supply number 4; and a setting value of 1000 in the preset counter number 5, we write in NODAL:

```
SET POW(4,"CCV")=10       for the power supply
SET TIM(5,"CCV")=1000     for the timing
```

For this example the programmer does not need to know the CAMAC address of the module: this is already coded in the first parameter called the equipment number.

He does neither have to know the CAMAC sequence to send the set value: this is imbedded in the codeof the second parameter (CCV: Current Control Value) called the property.

The use of equipment modules in general:

- eases dramatically the writing of applications,
- avoids the code duplication,
- once it is written and well tested, the software errors in CAMAC addressing are impossible,
- greatly facilitates the maintenance and testing; a short test program can be written in a few minutes by non-specialists.

Equipment modules exist already in the PS Control system but they are written in a compiled language and their execution is very fast.

For the ISOLDE 3 Control System, we use, for the first time, a stripped-down version of equipment module written in Nodal.

We have made a version of EM that, without loosing the essential in code capability and error treatment, is executed in about 90ms.

This value is acceptable in most of applications. Up to now 5 equipment modules have been identified:

- POW for Power Supplies
- IVV for Vacuum Valves
- IVP for Vacuum Pumps
- TIM for Preset counters
- SADC for Scanning ADC

See ANNEXE 2 for a detailed description of each EM.

4.2 Equipment Survey

A Survey system with Display will exist in each one of the three consoles. Due to the previously mentionned limitations, the survey program will run only when no other applications are executed on a console. This survey program will be started automatically when the operator pushes the option "TRUNK" on the console. The original "TRUNK" program has been modified: it now interrogates, as usual, the touch screen buttons and executes the Survey in a Loop.
The Survey will periodically scan the parameters belonging to the concerned CAMAC Loop and will display errors and inconsistencies between command set values and acquisitions. The list of parameters and the format of the display messages will be discussed with the concerned specialists.

4.3 Application Programs

This is a first and incomplete description of the application programs. In the definitive version of the present note, this part will be replaced by an appendix containing all the required details.
For this reason the figures are just examples.

4.3.1 Programs of CONSOLE 1

CONSOLE 1 concerns the controls of the Vacuum system, of the tape transport, and the existing beam diagnostics. The first page (Fig.19) contains the selection between the three systems. Vacuum has been separated in two zones: separator zone and experimental areas.
The corresponding programs have identical structure.

PUMPS
VALVES
CONTROL

The corresponding synoptic is in Fig.20.

This is a repetitive program (LOOP): this means that all indications contained in the display are refreshed periodically; (the period depends on the software and on the actions required).

The colours convention is the following:

- PUMPS
  - RED = OFF
  - GREEN = ON
  - YELLOW = Undefined

- VALVES
  - RED = CLOSED
  - GREEN = OPEN
  - YELLOW = Undefined

- BEAM Line

  The two pieces of Beam Line immediately preceding and following a pump will be:
  - GREEN indicating a Vacuum OK
  - RED indication Bad Vacuum.

If a pump or a valve are in LOCAL Control, this message will be displayed near the concerned element.
Interactions are possible using the Track-Ball.
Each control is interpreted as a request to change the status of the element (FLIP-FLOP): if green, it becames red and viceversa.
The element that one can control are: the pumps, the sectors and the valves.

If the element is in an undefined status (yellow) the control action is interpreted, for security reasons, as a request to go into OFF status for a pump and into CLOSED status for a valve.

HISTOGRAM This is a ONE-SHOT program (Non-repetitive)

The pressure values at the calling time are displayed on a logarithmic scale as in Fig.21. For each sector the penning value is in green and the Pirani reading is in yellow.
The pressure values are also displayed in digital form.

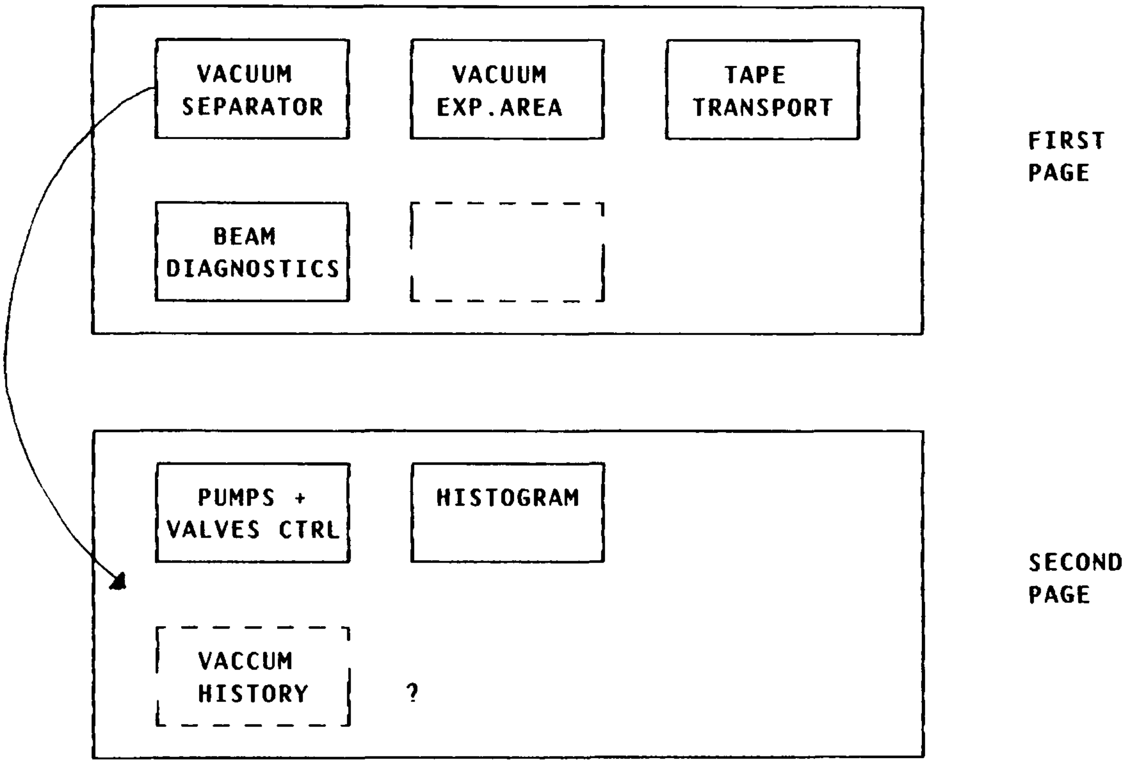
HISTORY

It is proposed to read periodically (Half hourly ?) all the pressure values and to store them in the memory. The values corresponding to the last, say, ten hours can subsequently be displayed for selected sectors (Fig.21).

TAPE TRANSPORT This program needs more detailed specifications.

BEAM DIAGNOSTICS The programs for the SLITS and for the FARADAY CUPS have not yet been specified.

CONSOLE 1 TREE



By pushing the "TRUNK" button, the SURVEY will be activated.

FIG. 19

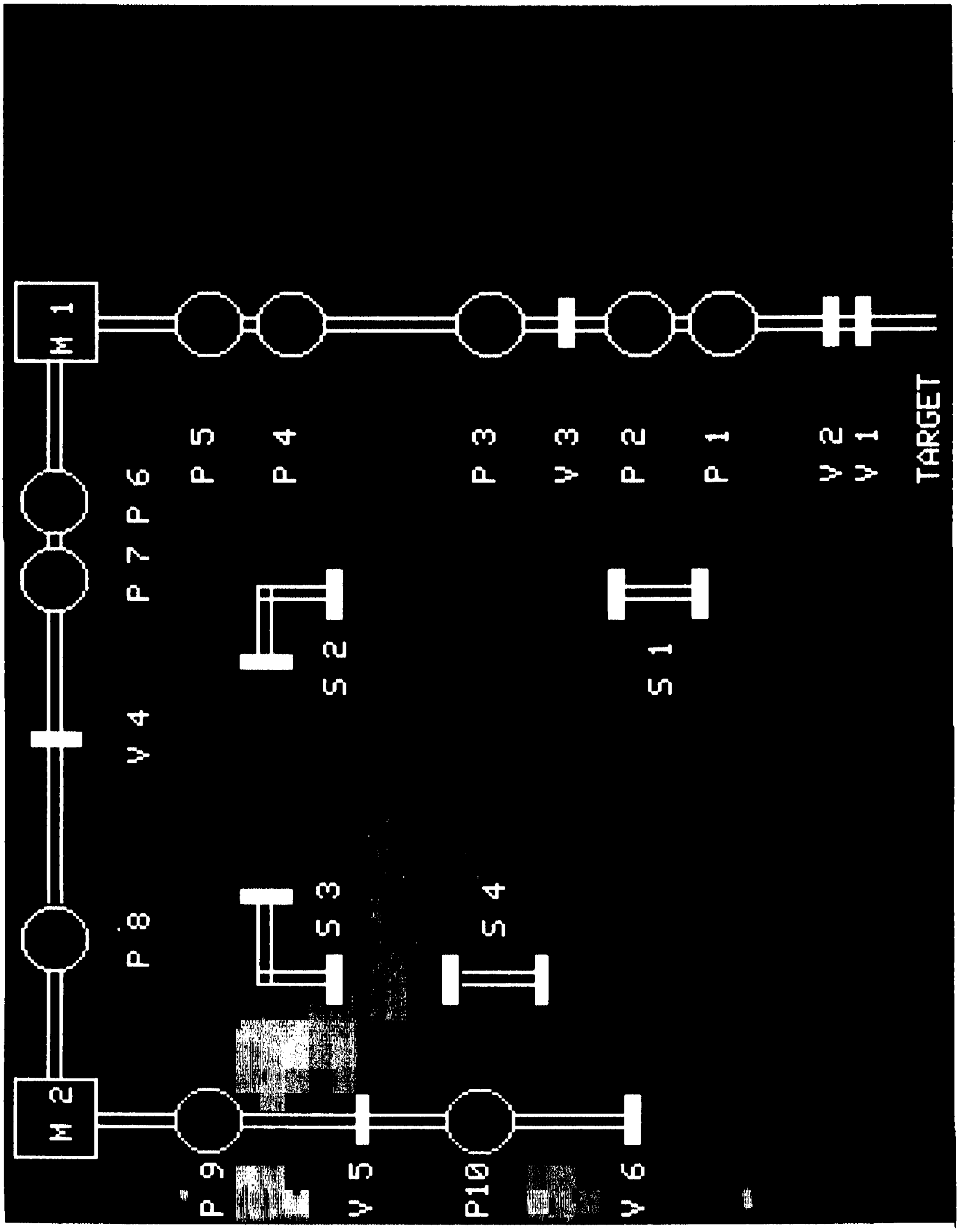

M 1
P 5
P 4
P 3
V 3
P 2
P 1
V 2
V 1
TARGET
P 6
P 7
S 2
S 1
V 4
P 8
S 3
S 4
M 2
P 9
V 5
P10
V 6

FIG. 20

VACUUM HISTOGRAM (SEPARATOR)

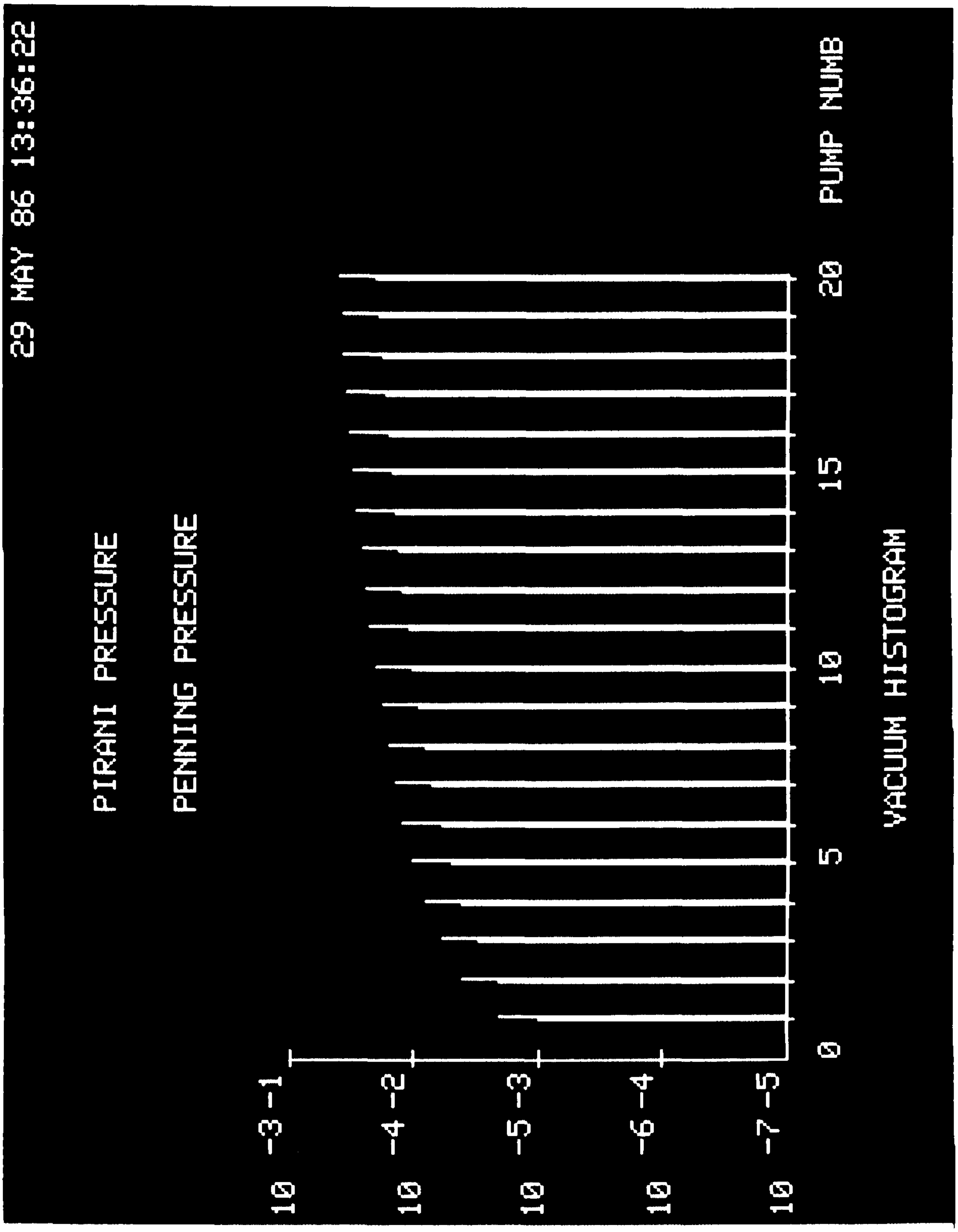


FIG. 21

4.3.2 Programs for CONSOLE 2

In LOOP 2 are grouped parameters of the accelerating devices (60 KV) and of the Ion source.

The first page on the touch screen permits a selection as shown in Fig.22.

60 KV
ACCEL.

This is a repetitive program.

The second page on the touch screen permits all actuations on the 60 KV power supply.
The first KNOB is connected to the Reference Control Value and two sensitivities are allowed: a coarse for fast reaching of the setting value and a fine one for fine adjustement. On the Colour TV are displayed and continuously refreshed all the parameters and the various interlocks of the 60 KV system (Fig.22).

ISOL.
TRANSFO

This is a repetitive program.

By depressing this button a second page is generated on the touch screen in which only buttom ON, OFF and RESET are present.
A serie of interlock and status conditions are repetitively displayed on the colour TV.

ION SOURCE +
TARGET

This is a repetitive program.

Nine separate power supplies are controled in this system (See Hardware Layout).
Five different configurations of these power supplies are used following the experiment requirements.

Each configuration uses only a certain number of power supplies selected between the nine existing ones.

The five configurations are:

- PLASMA Ionisation source with the line cathode,
- PLASMA Ionisation source with forced electron emission,
- Surface Ionisation source with ohmic heating (1),
- Surface Ionisation source with ohmic heating (2),
- negative Surface Ionisation source with ohmic heating.

Each configuration has a separate control program with related synoptics.

The system is easily extendable to other configurations. By depressing the program buttom a second page (see Fig. 23) is generated with the choice between the five configurations. By selecting a configuration a third page is generated on the touch screen giving access to the final program. No individual ON-OFF are foreseen because setting-up and closing beam programs are foreseen.

GENERAL CONTROL This is a repetitive program.

The concerned synoptic is generated.
Using the track-ball the selected power supply is connected to a knob.
At the start of the program, if a power supply is found to be OFF, its control value is set automatically to zero. In this case a setting-up procedure is necessary.

<u>Remark</u>: An important number of status and interlock messages need to be displayed. If this number will result too big for the colour TV, a second B/W display should be added.

CLOSING BEAM This is a one-shot program.

When the experiment is terminated, this program will permit to switch off the power supplies and to save the last setting values in a table for subsequent use.
The switching off requires probably a special programmed procedure that must be specified by specialists.

SETTING UP This is a one-shot program.

The program will switch on only the concerned power supply and will put the required settings following a procedure specified by specialists.

OUT GASING TARGET Program not yet specified.

4.3.3 <u>Programs of CONSOLE 3</u>

In LOOP 3 are grouped the controls of the analysing magnets, beam transport elements and extraction electrode movement.

In the first page (see Fig.24) we find a first choice between separator zone and experimental zone. These programs for the two branches of the tree are similar but, of course, in the second group there are no programs for the mass meter.

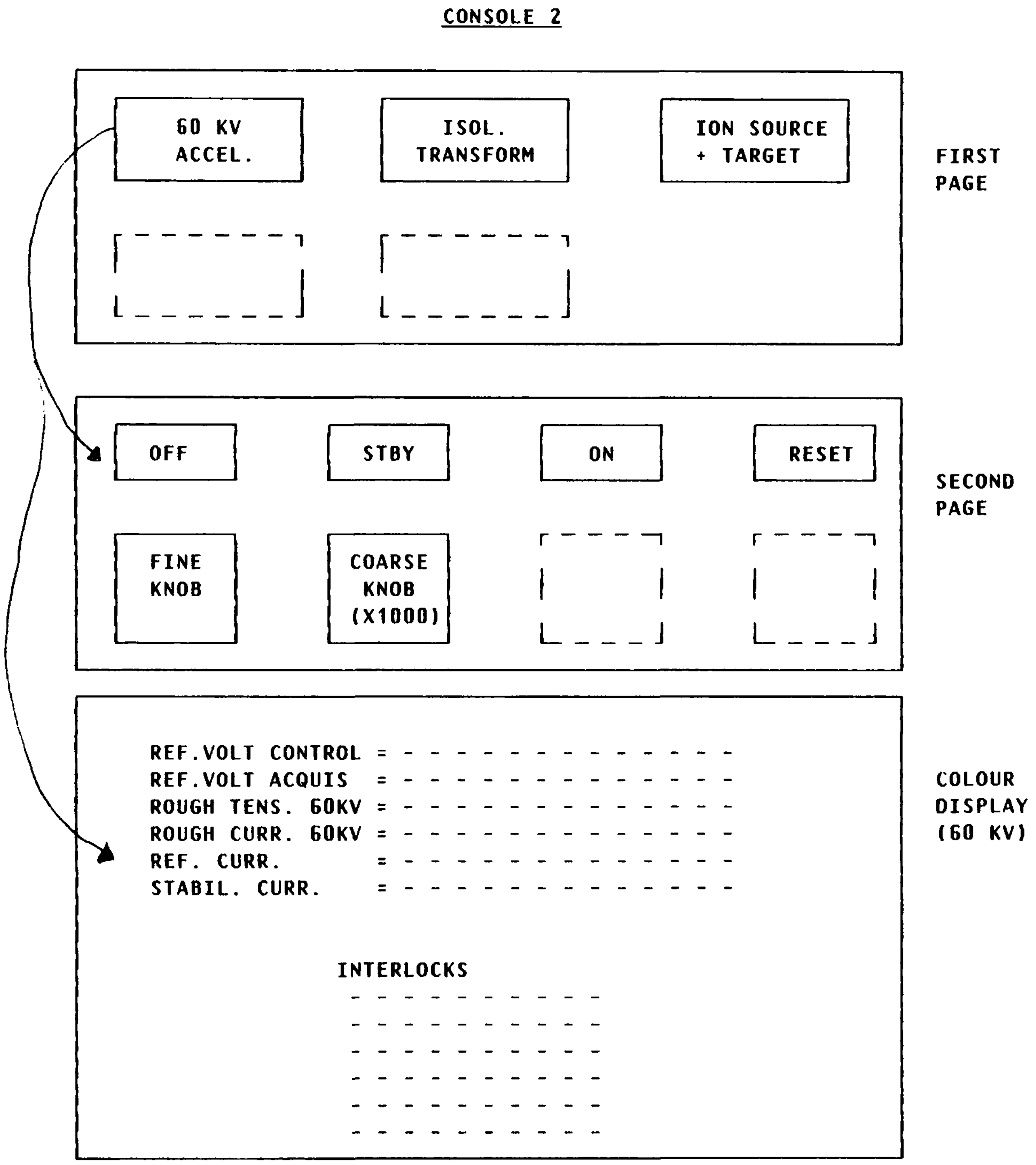

CONSOLE 2
60 KV
ACCEL.
ISOL.
TRANSFORM
ION SOURCE
+ TARGET
FIRST
PAGE
OFF
STBY
ON
RESET
SECOND
PAGE
FINE
KNOB
COARSE
KNOB
(X1000)
REF.VOLT CONTROL = - - - - - - - - - - - - - -
REF.VOLT ACQUIS = - - - - - - - - - - - - - -
ROUGH TENS. 60KV = - - - - - - - - - - - - - -
ROUGH CURR. 60KV = - - - - - - - - - - - - - -
REF. CURR. = - - - - - - - - - - - - - -
STABIL. CURR. = - - - - - - - - - - - - - -
INTERLOCKS
COLOUR
DISPLAY
(60 KV)

FIG. 22

INDIVIDUAL CONTROL This is a repetitive program (Fig.24).

Either knob can be connected to any of the presented elements. Using the track ball one first select a parameter and one connect it to a knob by depressing the valid button near the knob.

In this way any two selected parameters can be controled at the same time. This program is inteded only for adjustement of the different power supplies: no ON/OFF actuations are provided neither the treatment of the various status and interlocks. For this other specified programs are foreseen (See SETTING and STATUS).
The "usual" operating procedure is to run first the SETTING program and to adjust after with the individual control.

SETTING UP This is a one-shot program.

This program switches on all power supplies (where this command exists) and sets them to the predefined control values. The setting procedure are defined by specialists.

SAVE This is a one-shot program.

The actual setting values are stored in a specific file into the memory module. The saved value can be, e.g., used subsequently by the setting program.

If required this program could be improved by providing several saving files (each one labeled with a name and a date), to cover different experiments or operational situations (ARCHIVES).

STATUS + DIAGNOSTIC This is a repetitive program.

By depressing this button a second page is displayed on the touch screen permitting actuations (Fig.25). At the same time a display is generated containing all status information and actuations.

The power supplies are grouped in sets of 8. To pass from a set to another one pushes the "NEXT" button. The track ball permits to select a power supply on the display: The touch screen interactions are then valid for the selected power supply.

This program is intended expecially for the hardware specialist: the presentation will depend on his specifications.

FIG. 23

ION SOURCE

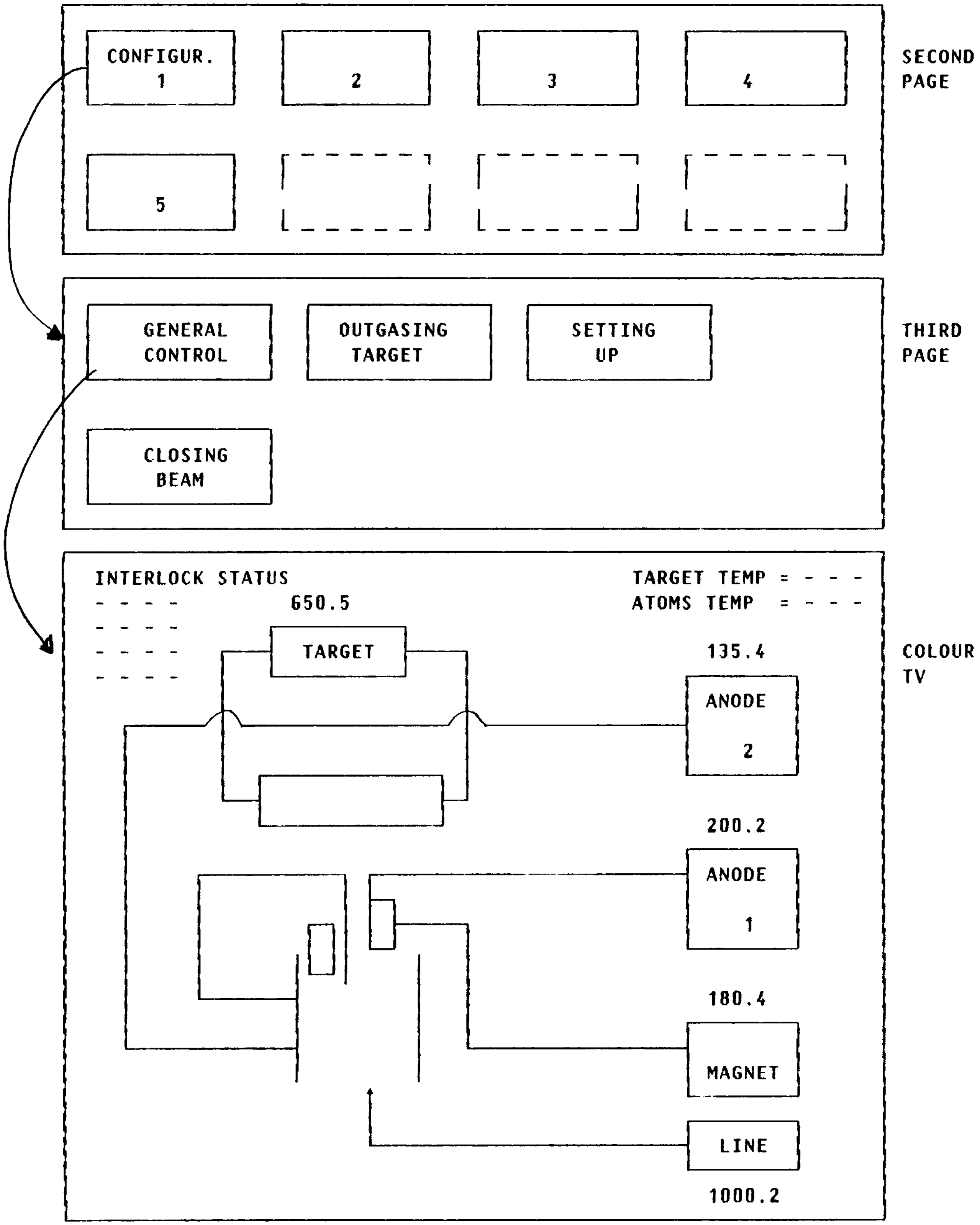


Fig. 23.1

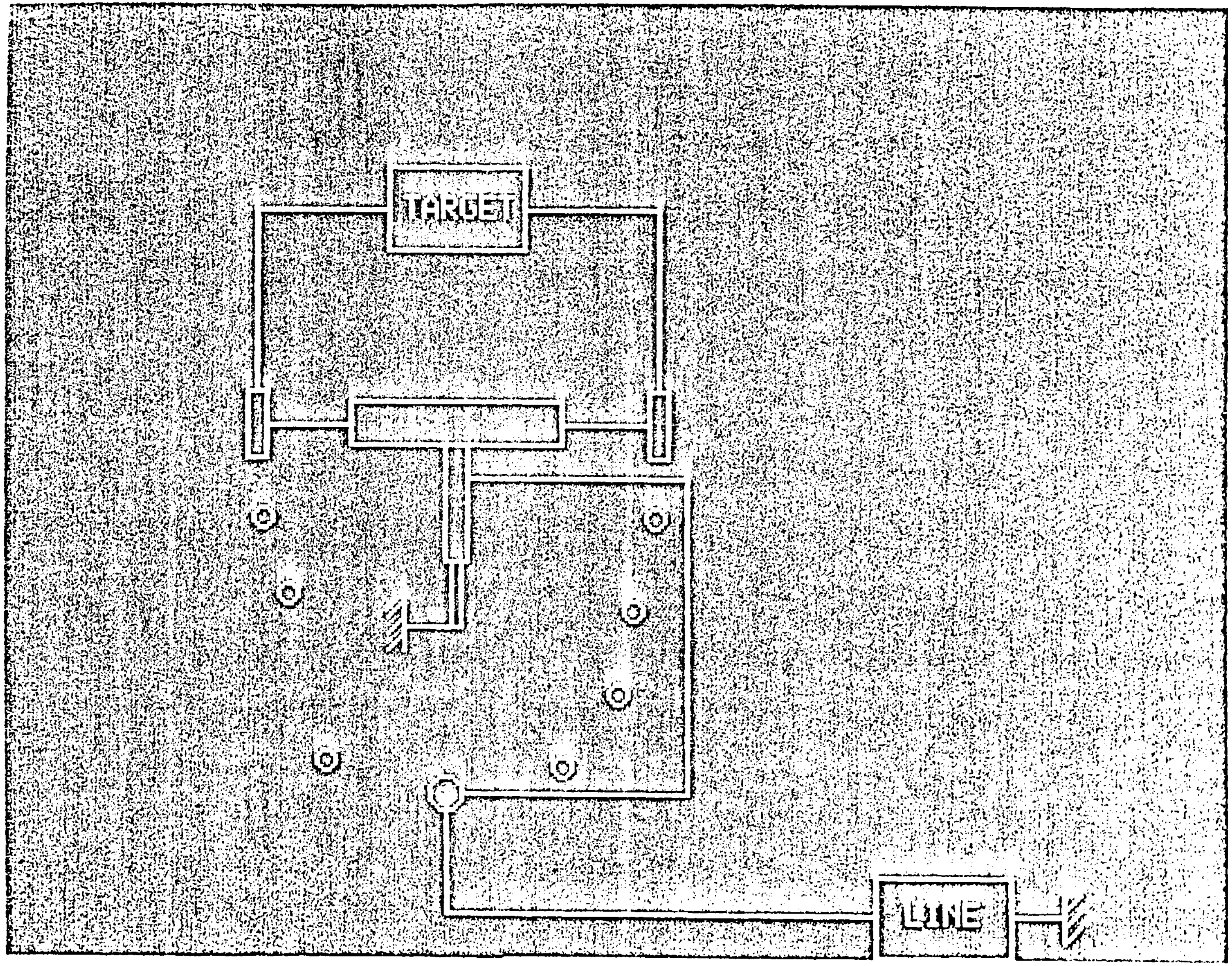


Fig. 23.2

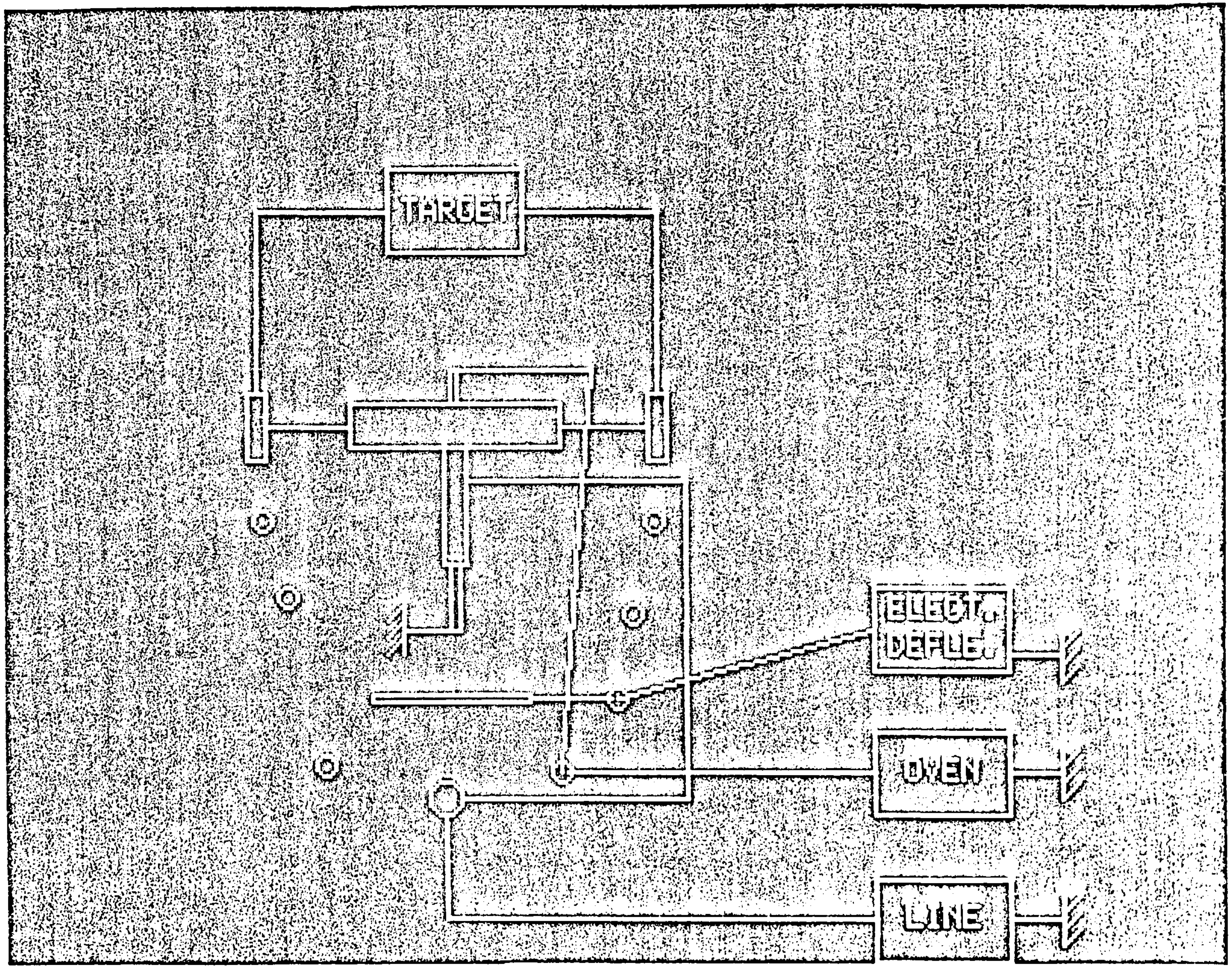
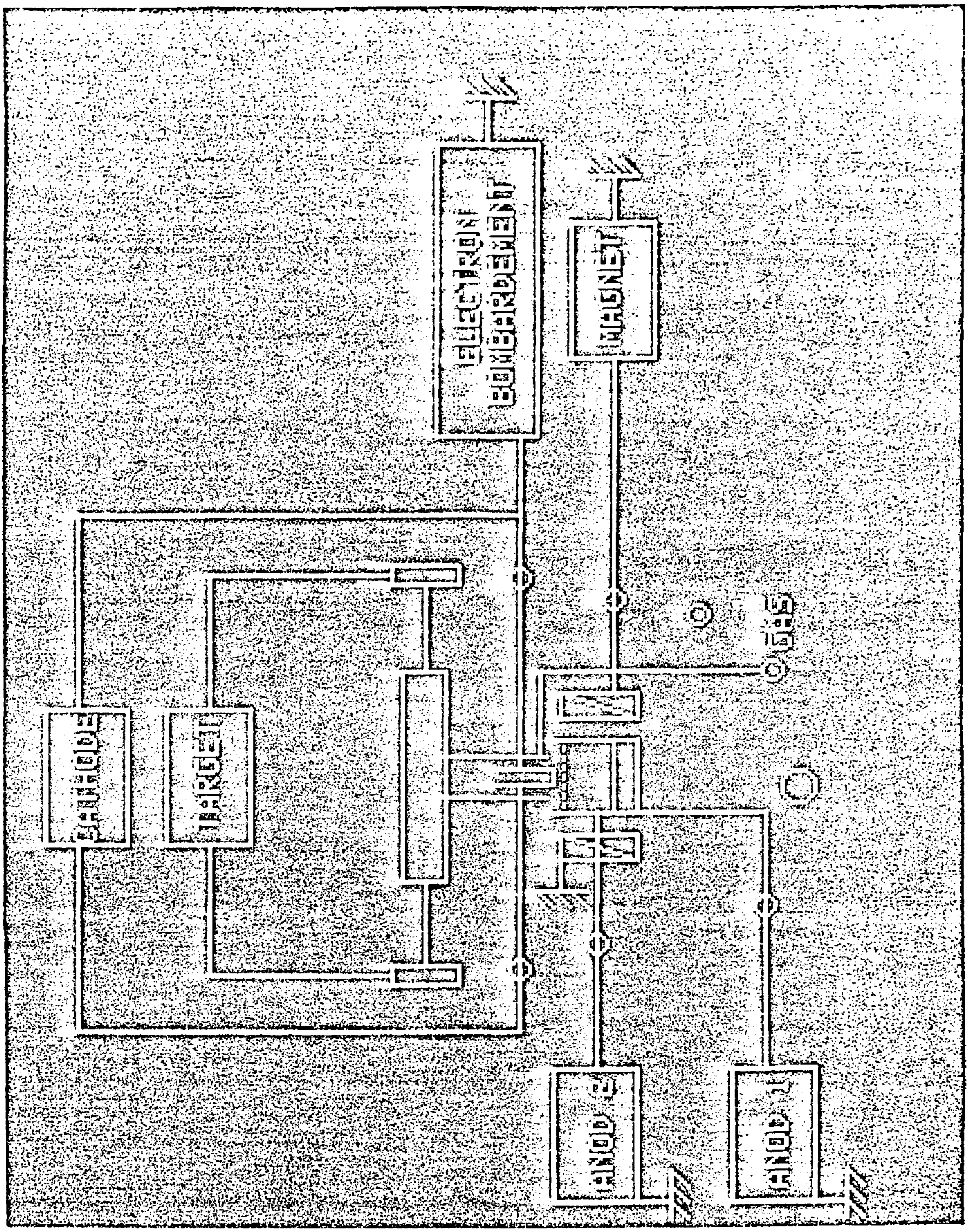
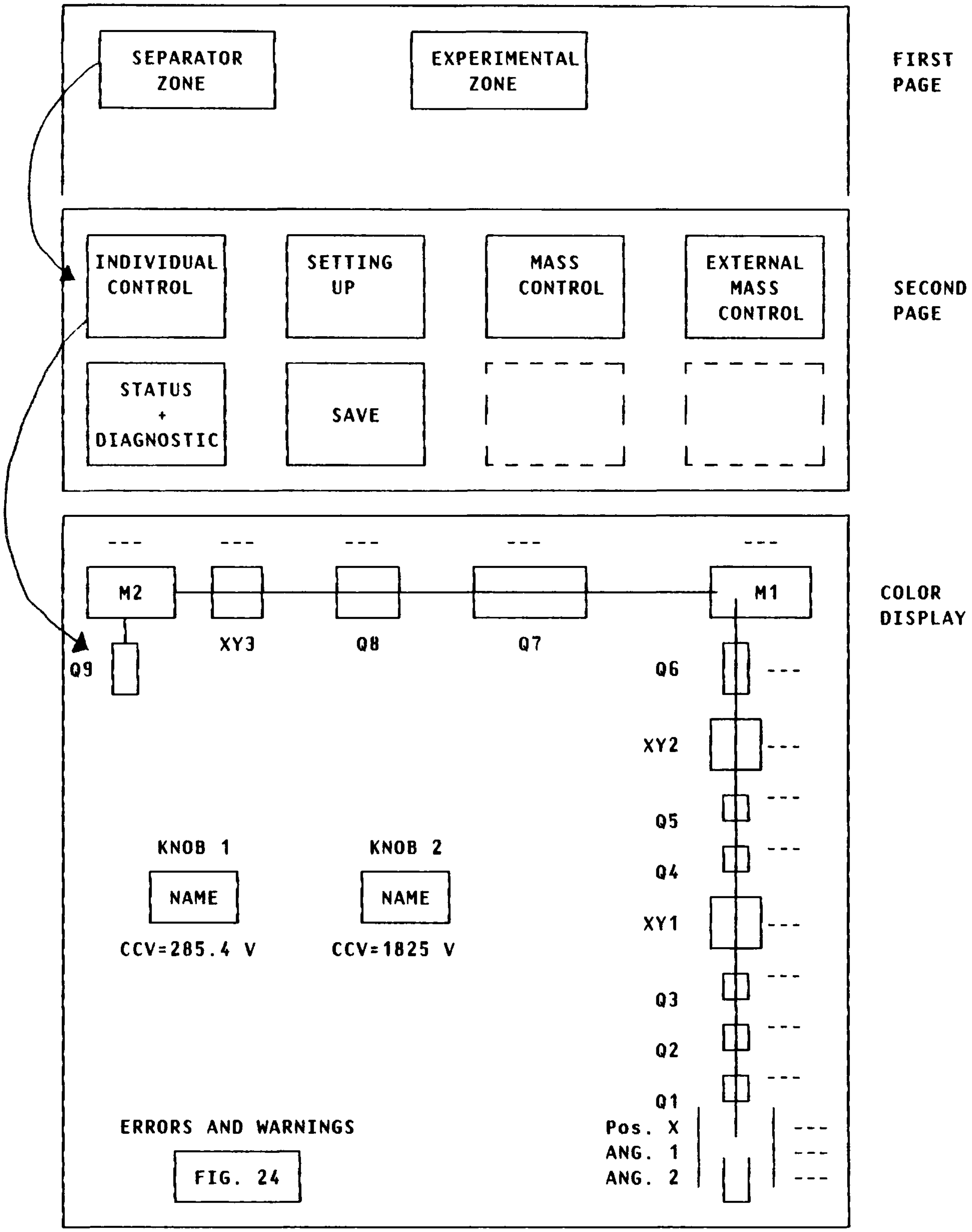


Fig. 23.3


ELECTRON
BOMBARDEMENT
MAGNET
CATHODE
TARGET
GAS
ANOD 2
ANOD 1

CONSOLE 3


SEPARATOR ZONE
EXPERIMENTAL ZONE
FIRST PAGE
INDIVIDUAL CONTROL
SETTING UP
MASS CONTROL
EXTERNAL MASS CONTROL
SECOND PAGE
STATUS + DIAGNOSTIC
SAVE

M2
M1
COLOR DISPLAY
Q9
XY3
Q8
Q7
Q6
XY2
Q5
Q4
XY1
Q3
Q2
Q1
KNOB 1
NAME
CCV=285.4 V
KNOB 2
NAME
CCV=1825 V
ERRORS AND WARNINGS
FIG. 24
Pos. X
ANG. 1
ANG. 2

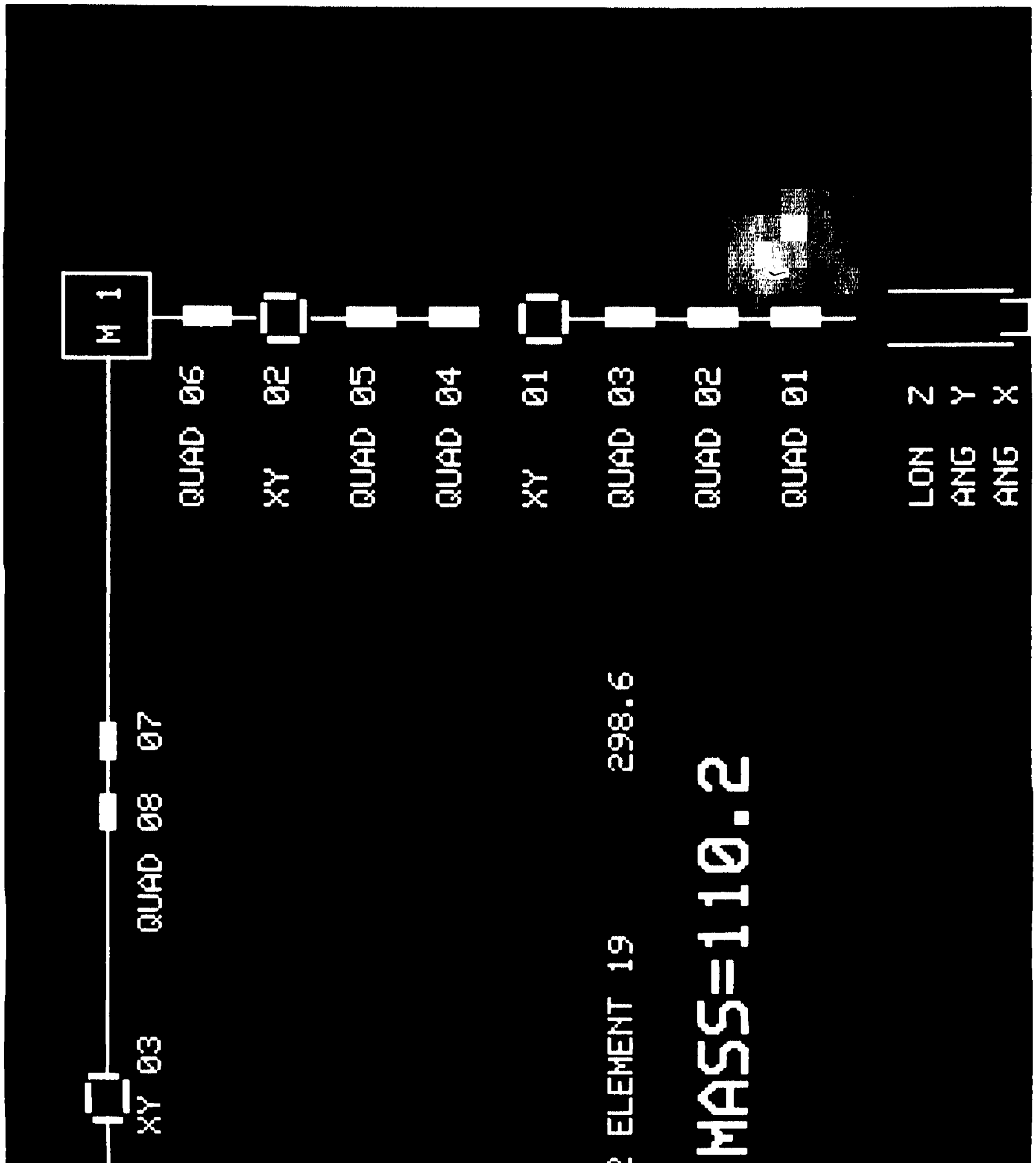

298.9A
M 2
XY 03
QUAD 08 07
M 1
Q 09
QUAD 06
XY 02
QUAD 05
QUAD 04
XY 01
QUAD 03
QUAD 02
QUAD 01
LON Z
ANG Y
ANG X
KNOB 2 ELEMENT 19 298.6
MASS=110.2

FIG. 24 bis

MASS CONTROL This is a repetitive program.

The program will command the first analysing magnet current and will read and display the mass values deduced from field measurements or from direct magnet current.

This program requires a calibration facility (See 3.7.1).

EXTERNAL MASS CONTROL This is a repetitive program.

This program is started, as the usual, by depressing the corresponding button on the touch screen.

Initials conditions, as the mass scan range, and other useful informations will be specified interactivelly from the main console. Once the program initiated, the user has the possibility to set locally the value of the selected mass. To do this he sends a 16 bit, BCD coded, word to an I/O register in the Camac crate (See hardware part).

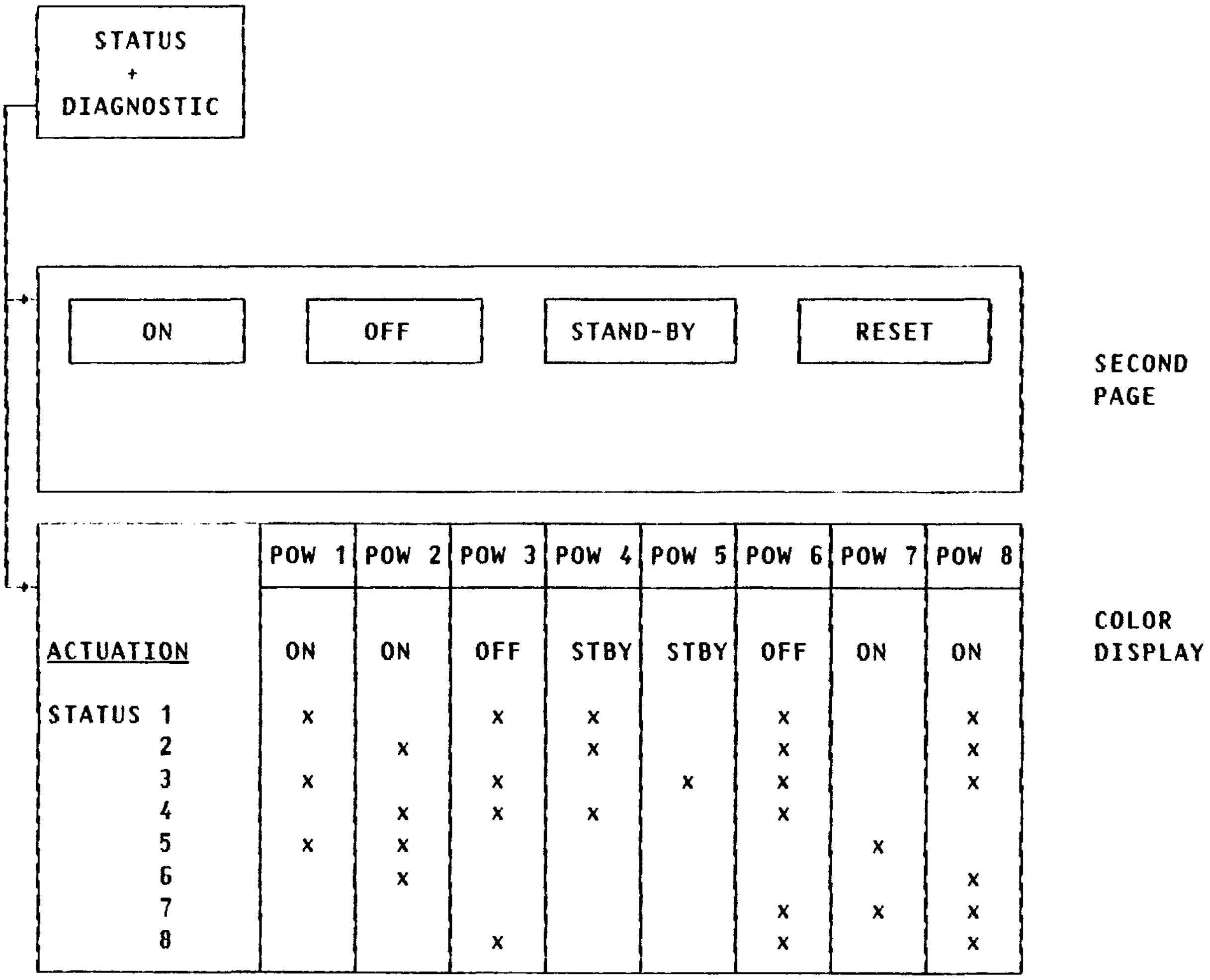
The program will read continously and will set consequently the magnet current
The exact value of the selected mass will be also continously displayed (Hall plate).
The user has also the possibility to locally stop the program: to do this, he will send a BCD code corresponding to the number 9999. The program will then return to the Trunk and activate the ALARM.

LOCAL DISPLAY AND SURVEY

The Survey program in CONSOLE 3 will display, as for the other loops, all useful information on the status of various equipments. It will also contain a continously refreshed information on the selected mass.

A B & W television screen will repeat in the experimental areas the Survey display.

CONSOLE 3



	POW 1	POW 2	POW 3	POW 4	POW 5	POW 6	POW 7	POW 8
ACTUATION	ON	ON	OFF	STBY	STBY	OFF	ON	ON
STATUS 1	x		x	x		x		x
2		x		x		x		x
3	x		x		x	x		x
4		x	x	x		x		
5	x	x					x	
6		x						x
7						x	x	x
8			x			x		x

STATUS PROGRAM

FIG. 25

ANNEXE 1

ISOLDE 3 Control Room

1) RACKS

An assembly of 6 Wilsher racks is installed on the left side of the control room. They are cooled by a GENERAL ELECTRIC air conditionner. For the time being only 3 racks are filled with computer equipment, leaving 3 racks in reserve:

rack 1 (general service rack):

- Floppy disc
  type Scientific Microsystem FT 0222 I-ER
- double hight EURO crate containing the electronic equipment for the keyboards.
- switch unit for the floppy
- switch unit for the printer
- switch unit for the hard copy unit
- patch panel for video signals, enables the temporary or permanent transmission of video signals from the control room to the Proton Hall.

rack 2 (mother crates):

- system SC (or reserve)
- system 1, ISOLDE 3

rack 3 (mother crates):

- system 2, ISOLDE 3
- system 3, ISOLDE 3

2- Printer / Hard Copy Unit

- There will be one printer (TEXAS INSTRUMENTS OMNI 800), which has to be shared by the 3 ISOLDE 3 systems. The corresponding switching unit is installed in rack 1.
- A black and white hard copy unit (Tektronix 4632) has also to be shared by the 3 ISOLDE 3 systems.
  A manual switching unit is foreseen in rack 1. This unit will allow to connect any of the DICO/CODIME signals to the hard copy unit that means all video signals which belong to the main colour displays, the touch screen and possible additional display screens.

3- Mother Crates

The mother crate, setting in rack 2 and rack 3 are identically equipped. For details see drawning 1.

4- Control Desk

There will be a 6 bay control desk. Mechanically it is identical with the desks which are used in the PS MCR with exeption that:

- it is split in the middle (thus allowing to install, if necessary, a 7 th bay)
- the depth had to be reduced due to the limitted space in the ISOLDE 3 control room; consequently it will not be possible to install crates on the rack side of the bays.

The minimum outfit per system of control desk equipment will be:

- a keyboard, type EURO key
- a double unit 9" b/w monitor unit
- 1 tracker ball
- 2 knob encoders
- 1 colour display, type BARCO CDCT 5151

There will be space to install, if necessary, further 19" rack mountable equipment. Total available space per system (in addition to the space already filled by the above mentionned equipment):

15 + 5 units

The 6 bays are attributed to the 3 systems in the following way:

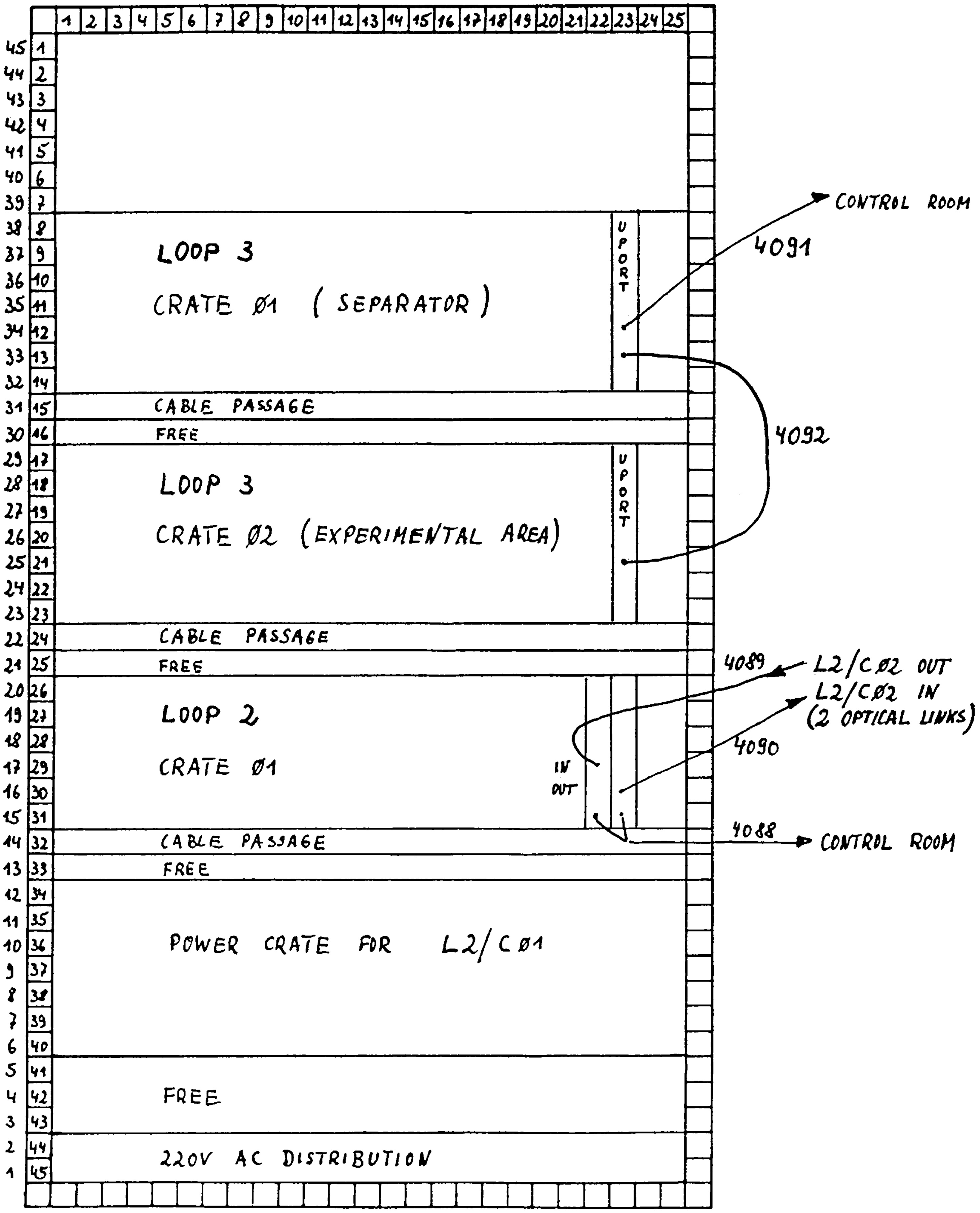
<u>bay</u> 1 and 2	<u>CONSOLE</u> 2 Transformer 60 KV Ion Source + Target Supplies
<u>bay</u> 3 and 4	<u>CONSOLE</u> 1 Vacuum Tape Transport Beam Diagnostics
<u>bay</u> 5 and 6	<u>CONSOLE</u> 3 Analysing Magnets Beam Transport Elements Extraction Electrode

See also the annexed drawing.

RACKS FOR COMPUTER EQUIPMENT

8.04.86

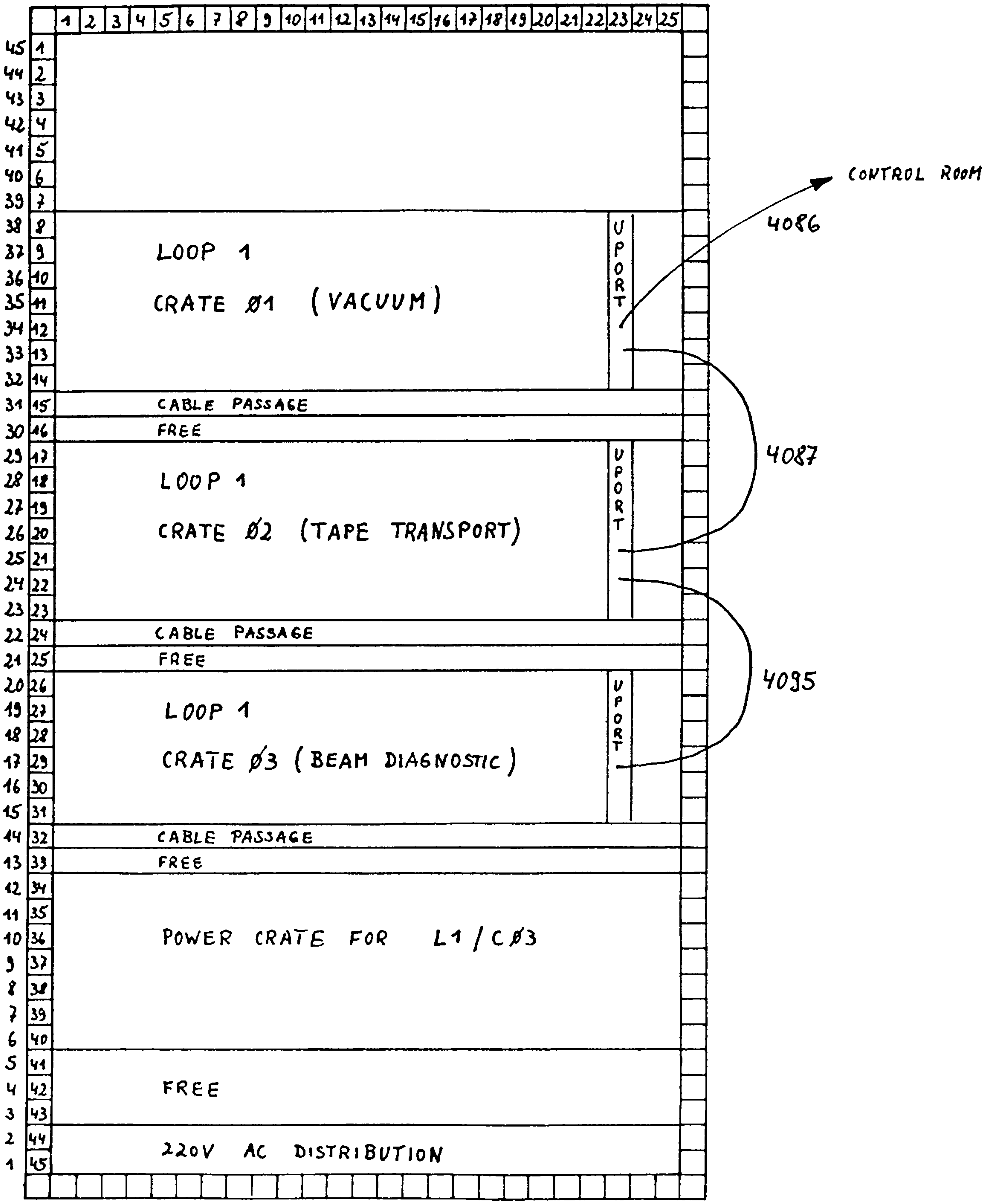
LOCATION : PROTON HALL
RACK NUMBER : 02



RACKS FOR COMPUTER EQUIPMENT

8.04.86

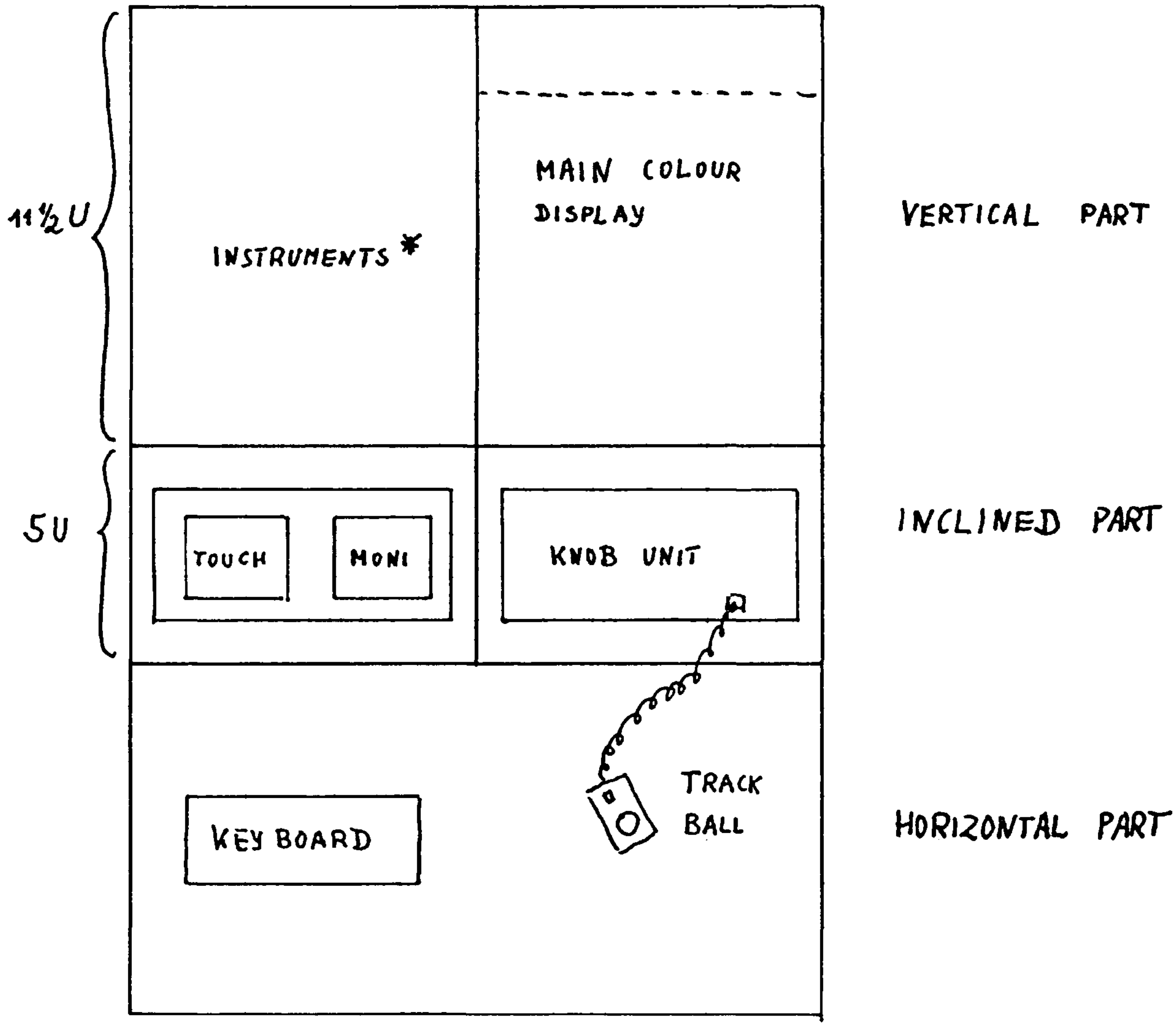
LOCATION : PROTON HALL
RACK NUMBER : 01



GENERAL LAYOUT OF CONTROL DESK

ISOLDE 3 CONTROL ROOM

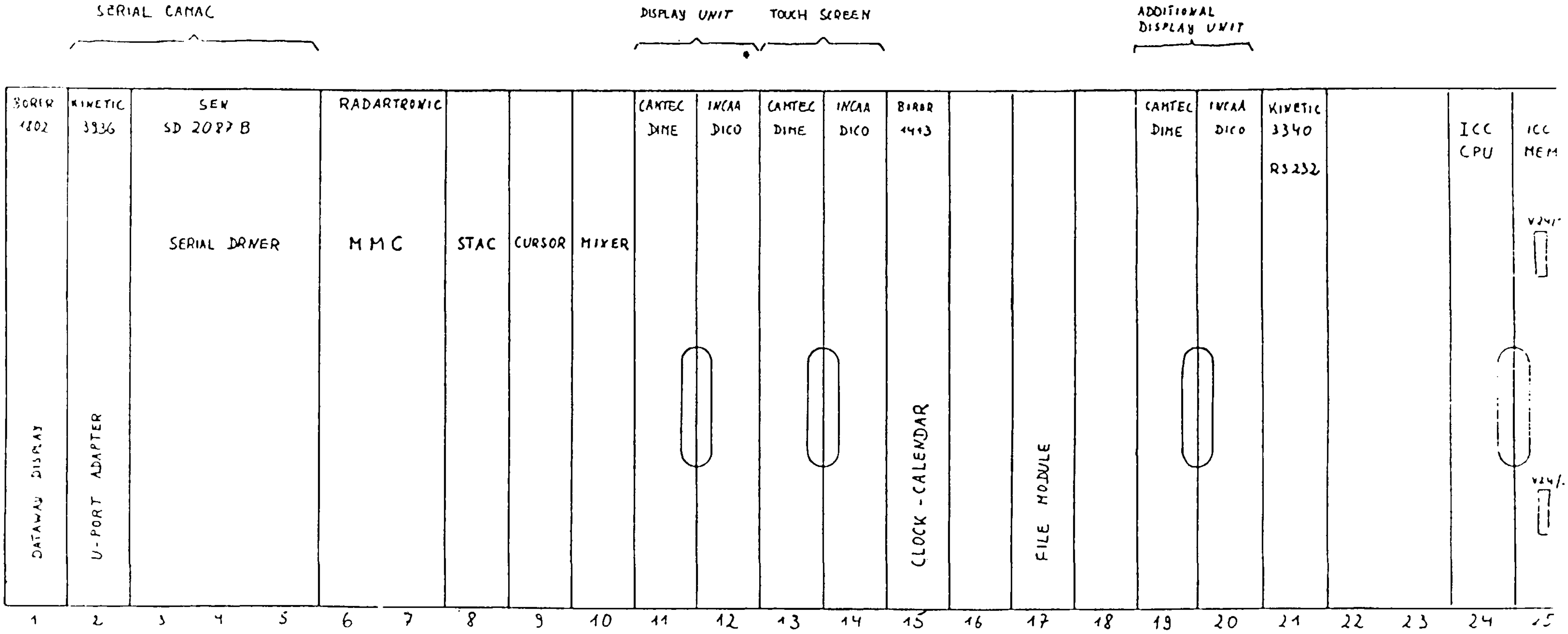
(identical for the 3 loops)



* FREE SPACE FOR OSCILLOSCOPS, DVMs, COUNTERS OR OTHER SPECIAL MEASURING INSTRUMENTS

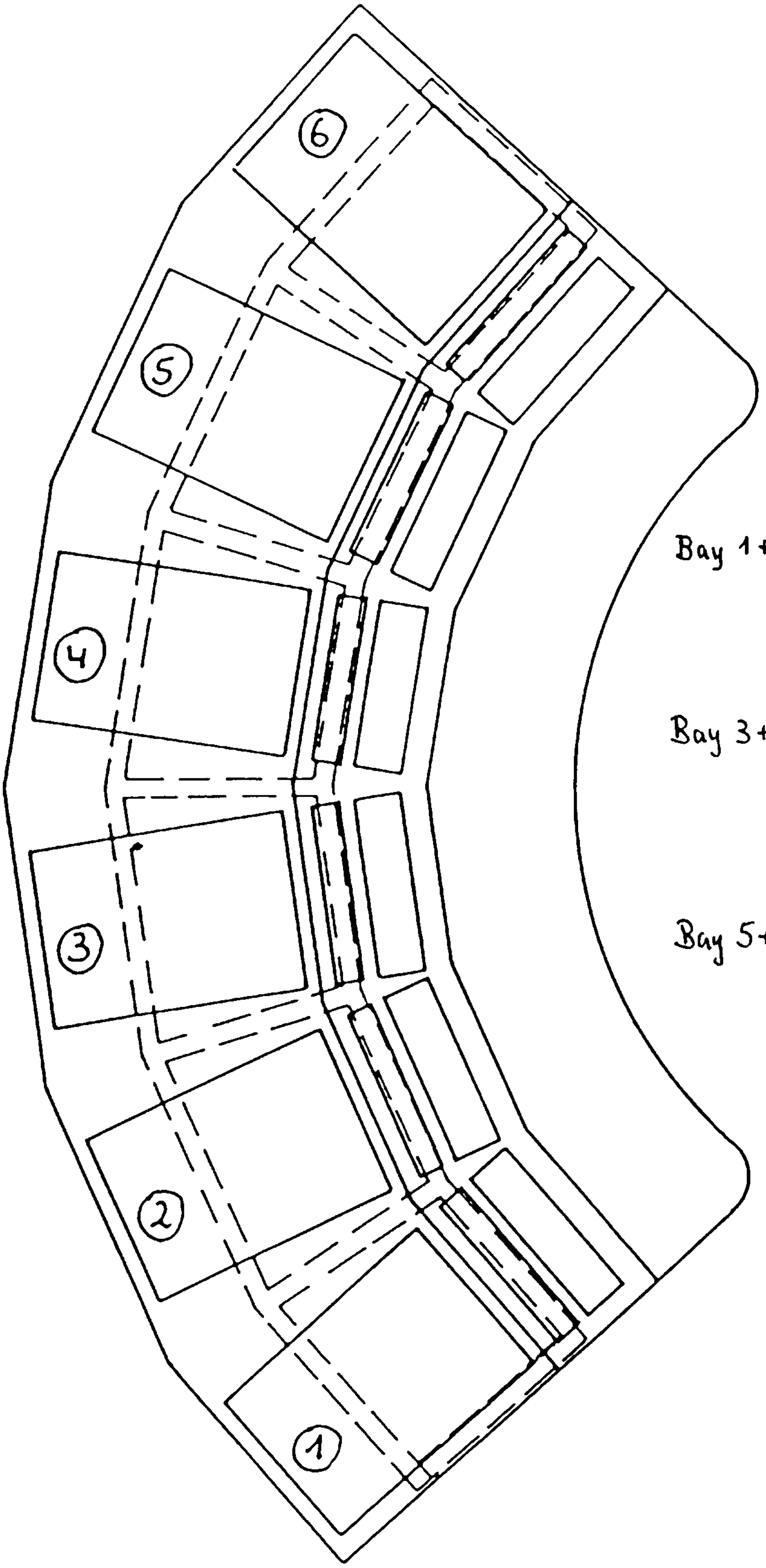
28/5 85
LUSTIG
27/11/85

SLOT ATTRIBUTION IN MOTHER CRATE FOR ISOLDE III PROJECT



KINETIC 3340
for printer

V24/1 → TERMINAL
V24/2 → FLOPPY OR
GANDALF

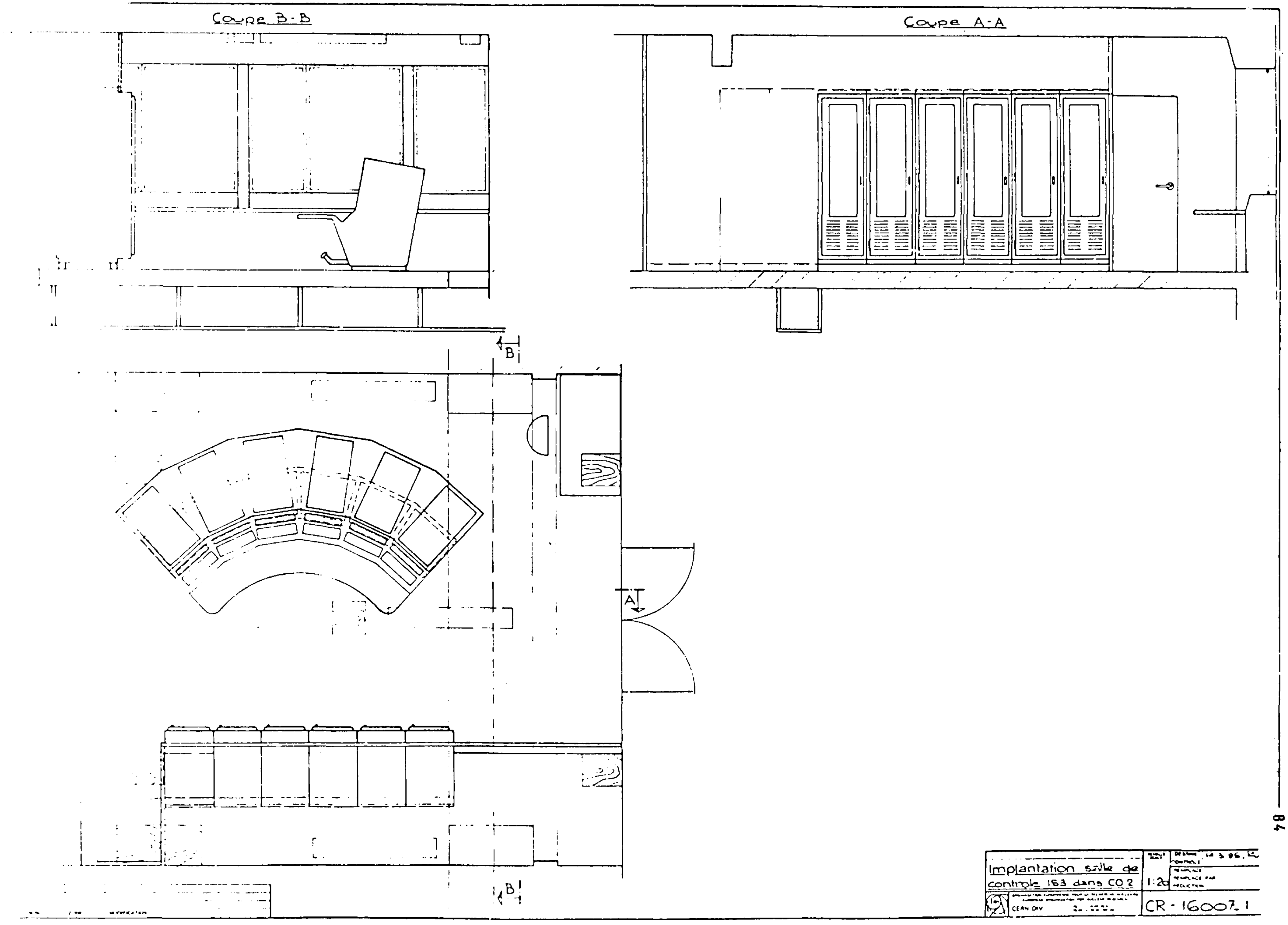


Bay 1+2 = CONSOLE 2
Transformer
60 KV
Ion Source + Target Supplies

Bay 3+4 = CONSOLE 1
Vacuum
Tape Transport
Beam Diagnostics

Bay 5+6 = CONSOLE 3
Analysing Magnets
Beam Transport Elements
Extraction Electrode

ISOLDE 3 CONTROL DESK


Coupe B-B
Coupe A-A
B
B
A
Implantation salle de controle 163 dans CO 2
1:20
14.3.86
CERN DIV
CR - 16007.1

ANNEXE 2

1. USE OF THE EM

The E.M. are 2 parameters defined functions written in NODAL and stored in defined function area. The first parameter is the equipment number: EQ.N; the second parameter is the property for control or acquisition, trough a CAMAC unit, of a special parameter of the equipment: PRO

So FUN(EQ.N,"PRO")

for example the function:

a) SE POW(1,"CCV")= 1000
means write in the register A of a QUAD the value to set 1000 Amps on Power supply 1.

b) SE CCAV(1)=POW(1,"CCV")
means read in a QUAD register B, the current value on Power supply 1 and put this value in the variable CCAV (1).

2. GENERATION OF EM

For this purpose, we need 2 programs:

a) Program PROGEN to generate all constants and variables used in the module EM. EX. POWGEN

b) Program PRO1 to create the properties themselves. EX. POW1

2.1 Description of PROGEN

The variables are grouped in NODAL blocks:

a) Property block: $S PROX(K)="PRO...."

b) Hardware address: SE HALC X(EQ.N)=[[0101

The name of the array for the PRO (perty) and the HALC have to be different for each EM specially when the EM are in the same defined area.

In the 16 bits word HALC, we put 2 addresses: the LOOP number and the CRATE number:

15 8	7 0
00000001	00000001

These 2 blocks are always present. The other blocks depend of the module itself. The generation is made by the block director; we have to use different block numbers in the different PROGEN if we want to use many EM in the same console.

Examples:

```
21.01 %*************CONSTANTS GENERATION FOR IVP FUNCTION********
21.02 %                     FOR SEPARATOR
21.03 %
21.10 DO 22;DO 23;DO 24;DO 25;DO 28
21.90 % END

22.01 %***************DEFINITION OF PROP. IVP*********
22.02 %
22.10 DIM-S PROP;SE N.PROP=7
22.15 $S PROP(1)="SWICHP";$S PROP(2)="STAQCP";$S PROP(3)="STAQDP"
22.20 $S PROP(4)="ADRCP";$S PROP(5)="ADRAP";$S PROP(6)="ADRBP"
22.25 $S PROP(7)="INITP"

14.01 %******************SET VALUE OF DIFFERENT ADDRESSES***********
14.02 %
14.10 FOR I=1,N.VAC;SE HALCV(I)=[[0101
14.15 FOR I=1,N.VAC;SE HANAV(I)=[[0400
14.20 FOR I=1,4;SE HABV(I)=(I-1)*2;
14.25 SE HABV(5)=0
14.27 %
14.90 SE QX=0;SE DX=30;SE DY=7
```

2.2 Description of PRO1

In the first block, we have to test the EQ.N validity and we define the index K corresponding to the property. In the second block, we decode the hardware addresses.

Example:

```
3.01 %*************CHECK OF PARAM. RANGE OF POW-FUN****************
3.02 %
3.04 IF EQ.N<1; SE ARG(1)=41;DO 91
3.05 IF EQ.N>N.POW; SE ARG(1)=42; T ! ARG(1);DO 91
3.10 %
3.11 SE K=FIND(PROP,P.PRP)
3.12 IF K<1; SE ARG(1)=43;DO 91
3.13 IF K>N.PRO; SE ARG(1)=44;DO 91
3.90 IF K<>-1;%TY EQ.N PRO(K) K

4.01 %************DEF CAMAC ADRRESSES OF POW***********************
4.02 %
4.05 SE CN=AND(HALC(EQ.N),[[000F)
4.07 SE LN=SHIFT(HALC(EQ.N),-8)
4.09 SE AN=AND(HANA(EQ.N),[[000F)
4.11 SE NN=SHIFT(HANA(EQ.N),-8)
4.99 % T !!"CRATE-" CN "LOOP"LN "SLOT="NN "QUAD ARD.=" AN
```

For each property (K), one block is built.

for example in POW1, K=6 for property "CCV"

```
35.01 %**************WRITE CURRENT IN AMPS ON POW. SUP.*************
35.02 %***********OR READ LAST CURRENT VALUE IN DATA TABLE**********
35.03 %
35.04 %    K=6   "CCV"      FLAG=-1  IN WRITE MODE
35.05 %
35.14 IF FLAG=1;GO TO 35.40
35.15 IF VALUE<MIN(EQ.N);SE ARG(1)=47;DO 91
35.17 IF VALUE>MAX(EQ.N);SE ARG(1)=48;DO 91
35.25 SE CCVA(EQ.N)=VALUE
35.26 SE CC=VALUE*SCLW(EQ.N)
35.27 SE SCAM(LN,CN,NN,AN+2,16,QX)=CC;IF QX<>3;DO 95
35.29 SE TR=SCAM(LN,CN,NN,0,25,QX);IF QX<>3;DO 95
35.30 RETURN
35.40 % FLAG=1 FUNCTION IN MODE READ
35.42 VALUE CCVA(EQ.N)
```

The general procedure for create one EM. is:

a) with PROGEN, put the variables in the interactive zone, save them in our file 17 and after load them in defined area:

```
OLD<17>PROGEN; RUN   or   DO 11 (director block)
SAVE<17>DATPRO  ALLV
LDEF<17>DATPRO
```

b) with PRO1 create the defined function:

```
OLD<17>PRO1
DEF-FUN PRO(V.EQ.N,S-P.PRO)     (or DO 98)
```

c) save all defined area; variables and functions: SDEF<17>FEM

d) so next time, we can load directly the defined area:

```
LDEF<17>FEM
```

3. SETTING OF THE DEFINED AREA IN EACH CONSOLE

3.1 CONSOLE 1

It concerns the Vacuum and Tape transport we need IVP, IVV, SADC, TIM, 4 E.M. in the same console.

Procedure for generate 4 E.M.in the same defined area

```
ZDEF
OLD<17> ADCGEN; DO 31
LOAD<17> VACGEN;DO 11
LOAD<17> PUPGEN;DO 21
LOAD<17> TIMGEN;DO 41

SAVE<17>DAT4EM    ALLV
LDEF<17>DAT4EM

OLD<17> PUP1;DO 98
```

```
OLD<17> VAC1;DO 98
OLD<17> ADC1;DO 98
OLD<17> TIM1;DO 98

SDEF <17> F4EM
```

3.2 Console 2

It concerns the accelerating devices and ion source; we need POW, SADC.

Procedure for generate 2 EM. in the same defined area:

```
ZDEF
OLD<17> POWGEN;DO 1
LOAD<17> ADCGEN;DO 31
SAVE<17> DAT2EM          ALLV
LDEF<17> DAT2EM

OLD<17> POW1;DO 98
OLD<17> ADC1;DO 98

SDEF<17> F2EM
```

3.3 CONSOLE 3

It concerns the power supply of beam transport and extraction electrode movement. We need only POW:

```
OLD<17> POWGEN;DO 1
SAVE<17> DAT1EM       ALLV
LDEF<17> DAT1EM
OLD<17> POW1;DO 98

SDEF<17> F1EM
```

So at each time, we switch on the console, we have to load FNEM in the function area, ex: LDEF<17>F2EM for console 2. This instruction is put in the INIT program. For each modification in one E.M., we have to rebuilt the defined area by the complete procedure described before.

4. LIST OF PROPERTIES

A) POW= POWER SUPPLY

```
SE ST=POW(EQ.N,"PROW")       Read Mode    R
SE POW(EQ.N,"PROW")=Value    Write Mode   W
Camac Unit: (QUAD + Single Transceiver)
```

PROW	Mode	Value	Description
OFFQUAD	W	0	One QUAD chanel "OFF" only for EQ.N
	R	/	The status of each chanel for QUAD NN
POWER	W	1/0	Supply ON = 1 " OFF = 0 The status is kept
STBY	W	0	Supply STBY = 0 in Data Table
RSET	W	0	" RSET = 0
CCAD	W	HEXA	W Status in Reg.A1 in digital [[01 = OFF [[02 = STBY [[04 = ON
	R	/	Read the last status in Data Table
CCV	W	Numb.	Load Reg.B with N for equipment EQ.N (Reg.B)
	R	/	Read the last value in Data Table
CCVD	W	HEXA	Write a value in digital in Reg.B
SAQD	R	/	Read Reg.C : status of the equipment
AQN	R	/	Read Reg.D + scaling factor = Physical Value
AQND	R	/	Read Reg.D : Value in digital
ADRC	W	HEXA	Write LOOP and Crate address ex [[0101
	R	/	Read L and C address in digital (data table)
ADRA	W	HEXA	Write N slot and A Subaddress of QUAD ex. [[040A slot 4, chanel 4 of QUAD
	R	/	Read N and A in HEXA in Data Table
MAXV	W	Numb. in	Write Maximum Value for equipment in data table
	R	Amp	Read Maximum Value for equipment in data table
MINV	W	Numb. in	Write Minimum Value for equipment in data table
	R	Amp	Read Minimum Value for equipment in data table

.../

PROW	Mode	Value	Description
			/...
SCLR	W R	Numb. /	Write scaling factor for DAC used in data table Read scaling factor for DAC used in data table For 12 bits DAC = 2.442
SCLW	W R	Numb. /	Write scaling factor for ADC used in data table Read scaling factor for ADC used in data table For 12 bits ADC = 0.409
INITL	R/W	/	Initialisation of QUAD Slot N All Reg. of all chanel at zero
"DELTV"	W R	Numb. /	Write the variation of Physical value in <u>pourcent</u> Read the pourcent admitted in data table

B) <u>SADC = SCANNING ANALOG TO DIGITAL CONVERTER</u>

SE PHV(EQ.N)=SADC(EQ.N,"PROM") Read Mode R
SE SADC(EQ.N,"PROM")=Value Write Mode W
Camac Unit: Scanning ADC + N x MUX

PROM	Mode	Value	Description
AQRAND	R	/	Read <u>a</u> physic value PHV in MUX chanel (EQ.N) Only <u>one</u> chanel
AQSCAN	R	/	Read from starting chanel = EQ.N to the last chanel <u>all the PHV (N)</u>
ADRCM	W R	HEXA /	Write LOOP and Crate adress in data table Read LOOP and Crate adress in the data table
ADRAN	W R	HEXA /	Write Slot and chanel for MUX for each EQ.N in data table Read Slot and chanel for MUX for each EQ.N in data table
ADRADC	W R	HEXA /	Write the number of chanel and Slot addr. of ADC in D.T. Read the number of chanel and Slot addr. of ADC in D.T. ex [[1F0A means 32 chanels (2MUX) + ADC in slot 10
SMRMU	W R	Numb. /	Write scaling factor for PHV (EQ.N) Read scaling factor for PHV (EQ.N)

C) IVV : ISOLDE VACUUM VALVES

SE ST.IVV(EQ.N,"PROV")　　Read Mode　R
SE IVV(EQ.N,"PROV")=Value　　Write Mode　W
Camac Unit: QUAD + Single Transceiver

PROV	Mode	Value	Description
SWITCHV	W R	0/1	Close = 0 or Open = 1 a Valve (EQ.N) Read the last action in Reg.A on Valve
STAQCV	R		Read Reg.C, the status of the valve
LOCAL	R		Read Reg.D, LOCAL = 1 Remote = 0
ADRCV	W R	HEXA /	Write Loop and Crate address Read Loop and Crate address
ADRAV	W R	HEXA /	Write Slot and subaddress of QUAD [[0400 Read Slot and subaddress of QUAD on DaTa Table
ADRBV	W R	Numb.	Write the bit address for value EQ.N in Reg.A1 + A2 Read the bit address for value EQ.N in data table
INITV	R		Initialis. of QUAD slot N, all Reg. of all chanel at zero

D) IVP = ISOLDE VACUUM PUMPS

SE ST=IVP(EQ.N,"PROP")　　Read Mode　R
SE IVP(EQ.N,"PROP")=Value　　Write Mode　W
Camac Unit : QUAD + Single Transceiver

PROP	Mode	Value	Description
SWITCHP	W R	0/1	Stop = 0 or Start = 1 a Pumps (EQ.N) Read the last action in Reg.A on Pumps
STAQCP	R		Read Reg.C : status of the Pumps
STAQDP	R		Read Reg.D : Vacuum status + Local + Pumps status
ADRCP	W R	HEXA /	Write Loop and Crate address Read Loop and Crate address in data table
ADRAP	W R	HEXA /	Write Slot and subaddress of QUAD Read Slot and subaddress of QUAD in data table
ADRBP	W R	Numb.	Write the bit address for Pump EQ.N in Reg.A1 + A2 Read the bit address for Pump EQ.N in data table
INITP	W		Initialisation of QUAD Slot N All Reg. of all chanel at zero

E) TIM = TIMINGS

SE ST=TIM(EQ.N,"PROT")   Read Mode R
SE TIM(EQ.N,"PROT")=Value   Write Mode W
Camac Unit : Preset Counter G.P.P.C.

PROT	Mode	Value	Description
AQN	R	Numb. of Pulse	Read Preset Register
CCV	W	Numb. of	Load Preset Register in start external Mode
	R	Pulse	Read last Preset counter value in data table
TRAIN	W/R		Choose Train C = external CRK
ADRCT	W	HEXA	Write Loop and Crate address ex [[0101
	R	/	Read Loop and Crate address in data table
ADRAT	W	HEXA	Write N Slot and A subaddress of PC.CV[[0B01
	R	/	Read N Slot and A subaddress in data table
MAXV	W	Numb. of	Write Maximum number of pulse train Mot 15 bit + signe ==> 32767
	R	Pulse	Read Maximum number of pulse train in data table
MINV	W	Numb. of	Write Minimum number of pulse train
	R	Pulse	Read Minimum number of pulse train in data table
INITT	W/R		Initialise both P.C.
TRIG			Produces an immediate output
STAQ	R	HEXA	Read the status register (Choose of Train in 3 first bits, Gate and so On)

ANNEXE 3

TESTING WITH MACINTOSH

For a better understanding, it is advisable to read ANNEXE 2 before (Sorry !)

For easy use of Mac Intosh, we have stored in defined area the E.M. needed for each crate.
We don't explain the details of this packed software, everything is in Annexe 2, we use the same program name for simplicity. As only difference, we store all programs and systems on the Mac disk instead of the file <17>.

Example of procedure the first time:

```
ZDEF
OLD POWGEN; RUN
SAVE DATPOW   ALLV
LDEF DATPOW
OLD POW1
DEF. FUNPOW(V-EQ.N, S-P.PRO)
SDEF FPOW
```

If no modification are needed, at each switch off, type LDEF FPOW.
Same procedure when printing NODAL.

A) Use of E.M. in Mac Intosh

1) You can type the complete instruction:
ex SE POW(10,"POWER")= 0 or 1
means put power supply 10 ON or OFF

2) If you don't want know anything about CAMAC, we can elaborate a little application program for your special test and you choose all the possibilities with the Mouse.

B) Example of Program

choice of status
choice of current value
choice of Reg. reading
initialisation of a QUAD

```
10.01 %*********INIT.MENU FOR ISOLDE POWER SUPPLY**********
10.02 %
10.10 SE QUIT.=0
10.11 SE MENU.=0;SE ITEM.=0
10.12 $S MENU(1,0)="STAT.CTRL"
10.16 $S MENU(1,1)="POWER STBY"
10.18 $S MENU(1,2)="POWER ON"
10.20 $S MENU(1,3)="POWER OFF"
10.22 $S MENU(1,4)="POWER RSET"
10.24 $S MENU(2,0)="CRT.CTRL"
10.26 $S MENU(2,1)="IN AMPERES"
10.28 $S MENU(2,2)="IN DIGITAL"
10.30 $S MENU(3,0)="INI.QD"
```

```
10.32 $S MENU)3,1)="INITL"
10.40 $S MENU(4,0)="READ.REG."
10.42 $S MENU(4,1)=" REG C"
10.44 $S MENU(4,2)=" REG D"
10.50 T!" USE MOUSSE FOR POWER SUPPLY TEST"
10.80 WH QUIT.=0; DO 16

14.01 %**********READ STATUS OF SUPPLY**********
14.02 %
14.12 IF ITEM.=3;SE ST=0;SE POW(I,"POWER")=ST
14.14 IF ITEM.=2;SE ST=1;SE POW(I,"POWER")=ST
14.16 IF ITEM.=1;SE ST=1;SE POW(I,"STBY")=ST
14.18 IF ITEM.=4;SE POW(I,"RSET")=8;

16.01 %**********SELECTION WITH MOUSE***********
16.02 %
16.10 SE SEL.=MHIT(MENU.,ITEM.)
16.12 IF MENU.=2;IF ITEM.=1;DO 17
16.14 IF MENU.=1;DO 14
16.16 IF MENU.=2;IF ITEM.=2;DO 18
16.18 IF MENU.=3;IF ITEM.=1;SE POW(1,"INITL")=0;SE POW(5,"INITL")=0
16.20 IF MENU.=4;IF ITEM.=1;DO 20
16.22 IF MENU.=4;IF ITEM.=2;DO 22

17.01 %**********ENTER EQ.N AMPS*************
17.02 %
17.10 T!"TYPE SUPPLY NUMB= ";ASK N
17.20 T!"TYPE CURRENT IN AMPS= ";ASK C
17.30 SE POW(N,"CCV")=C
17.40 T! " VERIFY ON THE SUPPLY IF THE CURRENT IS THERE!!"

18.01 %**********ENTER EQ.N DIGITAL NUMBER****
18.02 %
18.10 T!"TYPE SUPPLY NUMB= ";ASK N
18.20 T!"TYPE CURRENT IN HEXA= ";ASK C
18.30 SE POW(N,"CCV")=C
18.40 T! " VERIFY ON THE SUPPLY IF THE CURRENT IS THERE!!"

20.01 %**********READ REGISTER C**************
20.02 %
20.10 T! "TYPE NUM. SUPPLY= " ;ASK N
20.14 SE ST=POW(N,"SAQD"); T! "REG C=" ST

22.01 %**********READ REGISTER D**************
22.02 %
22.10 T! "TYPE NUMB. SUPPLY= " ; ASK N
22.14 SE ST=POW(N,"AQN"); T! "REG D=CURRENT" ST
```

ANNEXE 4

NAMING STRUCTURE FOR ISOLDE 3 COMPONENTS

1) INTRODUCTION

The naming structure for ISOLDE 3 is based on the so-called Oscar Barbalat standard (abbreviated in O.B. name) introduced some years ago and now used in most of the PS systems.

For each element of Isolde 3 we propose to use a name composed of three groups of characters:

IX.YYYYNN

- the first two characters, IX, represent the process and sub-process. In our case the process is always I for ISOLDE;
- the next group, YYYY, up to 4 characters, represents a contracted but (hopefully!) meaningful description of the element in object;
- the third group, NN, optional, is a progressive numerotation for elements of the same kind.

Remark 1: the following list of names concerns only those elements that are controlled by computer (identified up to now): we think it should be extended later to cover all parameters of the ISOLDE 3 project.

Remark 2: in case of progressive numerotation, NN is intended to start with 01 assigned to the element nearest to the source and so increasing towards the Proton Hall.

2. PROCESS AND SUBPROCESS

We have identified 4 sub-processes:

IT	target + source complex
IL	beam line
IX	timing system
ID	beam disgnostics

3. LIST OF ISOLDE 3 NAMES

Using the previous naming structure, the proposed names list follows. Parameters are grouped per system as they have been identified during the computer control meetings in the past months.

A. Vacumm system

IL.VALV01 (to 12)	vacuum valves
IL.PUMP01 (to ??)	vacuum pumps
IL.VPIR01 (to ??)	Pirani gauges
IL.VPEN01 (to ??)	Penning gauges

B. HT inside the Faraday cage (60 KV)

IT.60HT	high tension power supply
IT.VROU	voltage on rough PS
IT.IROU	current on rough PS
IT.IREF	current in reference PS
IT.VSTB	voltage on stabilizer

C. Insulating transformer

IS.TRFO

D. Target and ion source

IT.VPEX	pre-extractor PS
IT.IPEX	pre-extractor current
IT.VAN(01 to 02)	anode PS
IT.IAN(01 to 02)	anode current
IT.VSMG	source magnet PS
IT.ISMG	source magnet current
IT.VTAR	target PS
IT.ITAR	target current
IT.VOVE	oven PS
IT.IOVE	oven current
IT.VLHE	line heating PS
IT.ILHE	line heating current
IT.VELB	electron bombardement PS
IT.IELB	electron bombardement current
IT.VFIL	filament PS
IT.IFIL	filament current
IT.ISS	ion source status
IT.TEMP(01 to 06)	temperature measurements

E. Beam transport

IL.QP(01 to 29)	electrostatic quadrupoles PS
IL.XYH(01 to 18)	horizontal dipoles PS ⎫ x y
IL.XYV(01 to 18)	vertical dipoles PS ⎭ plates
IL.BEND(01 to 02)	bending PS
IL.MAG(01 to 02)	analysing magnet PS
IL.MASS	mass specification (user)

F. Extraction electrodes

IL.EEZ	extr. el. longitudinal movement
IL.EEX	extr. el. transversal(x) movement
IL.EEY	extr. el. transversal(y) movement

G. Measurement systems (beam diagnostics)

ID.TAPE(01 to ??)	tape transport parameters
IX.TAPE(01 to 10)	tape transport timings
ID.CUP	faraday cup
ID.HALL	hall plate
ID.SCAN(01 to ??)	scanners
ID.SLIT(01 to ??)	slits
ID.GRID(01 to ??)	grids

Distribution:

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