GSI Motion Control

System specifications

Revision:	0.7
Status:	Draft
Repository:	cosycvs
Project:	GSI-MotionControl
Folder:	.
Document ID:	CSL-SPE-07-32249
File:	GSI-MotionControl-syst-specs
Owner:	jdedic
Last modification:	May 16, 2007
Created:	April 1, 2007

Document History

Revision	Date	Changed/ reviewed	Section(s)	Modification
0.5	2007-04-04	Dedic	All	Created (at GSI)
0.6	2007-04-17	Dedic Kriznar	All, but 4 4	Specifications updated Specifications updated
0.65	2007-04-20	Dedic	1.1, 2.1.2, 2.2, 2.4.1, 3.1, 5.4.1	1.1 - implemented comment from R. Boywitt / 1:1~1:20 2.1.2 - fig. 3 caption extended 2.2 - implemented answer(s) from R. Boywitt 2.4.1 - implemented answer(s) from R. Boywitt 3.1 - implemented answer(s) from R. Boywitt 5.4.1 - implemented answer(s) from R. Boywitt
0.7		Dedic	2.4.1	2.4.1 – changed 1st paragraph (R. Boywitt)

Confidentiality

This document is classified as a `public document`. As such, it or parts thereof are openly accessible to anyone listed in the Audience section, either in electronic or in any other form.

Scope

This document covers the system specifications and requirements for motion control system for GSI.

Audience

All Cosylab and GSI employees.

Typography

This document uses the following styles:

A box like this contains important information.

A box like this would contain sidebar text.

Warning!
A box like this provides information, which should not be disregarded!

Glossary of Terms

GUI	Graphical User Interface
HW	Hardware
mEB	microIOC-M-Box-PMAC extension box (see sect. 1.2)
PMAC	Programmable Multi Axes Controller
SAT	Site Acceptance Test
SBC	Single Board Computer (embedded PC)
SW	Software

References

[1] Rotary encoder, TWK, CM50, CM 50 (Elektro-optisch, ø 50 mm, 18 Bit max., parallel) http://www.twk.de/E/pdf/10117ae0.pdf

[2] VEXTA, 5-Phase Stepping Motor Unit, CSK Series, Standard Type, TH Geared Type, OPERATING MANUAL, HP-4153

[3] Pflichtenheft Schrittmotorsteuerung - Boywitt/Schuhmacher, Strahldiagnose, 28.03.07 (GSI motion-related HW specification; motors, motor-drives, encoders…)

[4] eqmodel-dss (equipment model for the septum device, prepared by Udo Krause)

Table of Contents

Figures

Tables

1. INTRODUCTION

At GSI there are currently about 300 different accelerator insertion devices that include motorized movement mechanics. The purpose of this document is to characterize the functionality of the motor-controller system that would be able to interface/control all current and possibly even future motor-driven devices.

1.1. GENERAL DESCRIPTION OF THE MECHANICS

Typical range of movement for the mechanics is 50~1000 mm. Stepper motors connect to the drive-spindle over the 1:1~1:20 transmission mechanisms. Drive-spindle position increment is 5mm/rev.

Two types of position feedbacks were identified: linear potentiometer (analogue, variable resistance, installed in parallel with drive-spindle) and rotary encoder (digital, gray-code, absolute position). Details for the position feedback devices are given in section 2.4.

Addition feedbacks that the controlled-device may produce are positive/negative (in/out) limits and "touching" switch (handling relative proximity of two opposite-moving devices). Details for the position switches are given in section 2.5. Not all devices feature limit/proximity switches.

> The final positioning precision is the collective result of the entire system. Components with sufficient position precision should be used; i.e. mechanics, drive-spindle, position-encoder device, etc.

1.2. MOTION CONTROL SYSTEM

Motion control system must be able to communicate with the motor-drives (including brake circuitry), position feedback devices, limit (and other) switches, must respond to interlock signal, provide interlock signal for disabling other devices, and must provide device-moving signal to other systems. All aforementioned must be provided per each controlled axis. Besides that, it should provide means for low-level local access and remote control-system access.

The system is split into two parts; microIOC-M-Box-PMAC and microIOC-M-Box-PMAC extension box, in the following text referred as **`mEB`**. The reason for split design is the large distance between the controlled mechanics and positioning of the microIOC-M-Box-PMAC. microIOC-M-Box-PMAC is placed outside the tunnel and includes system-control and motion-control relevant intelligence. mEB is placed in the tunnel and is responsible for interfacing to motor-drives, position encoders, limit switches, and interlock input and output signals.

Design of a mEB should be modular by enabling installation of electronics for controlling 2 or 4 axes.

It is agreed that the initial system design of the microIOC-M-Box-PMAC and mEB and supplementary SW support will be fitted to the Septum system, described in sect. 3.1. I.e. mEB will be equipped with electronics for driving of 4 axes.

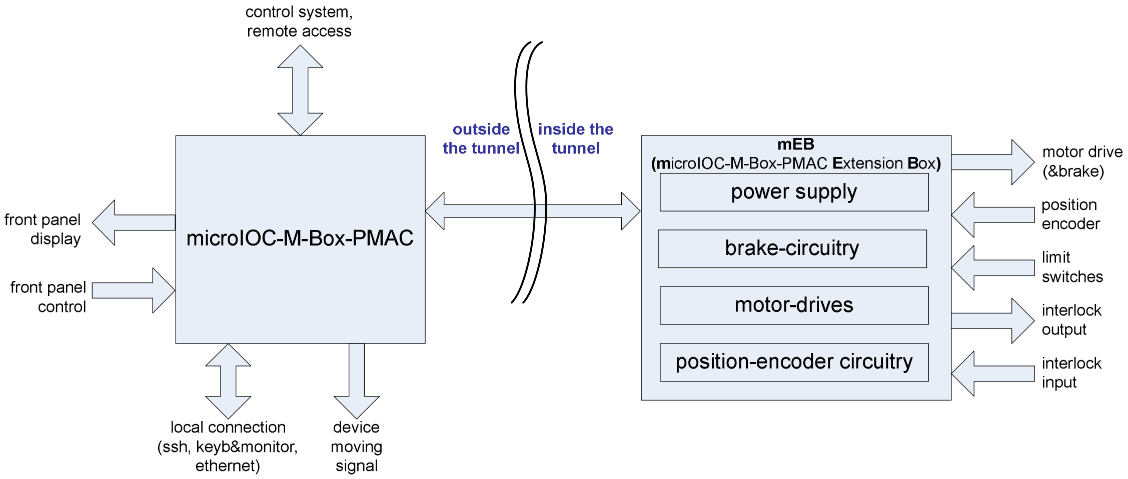


Figure 1 – microIOC-M-Box-PMAC and mEB

System overview of the control system access to the underlying HW is presented on Figure 2.

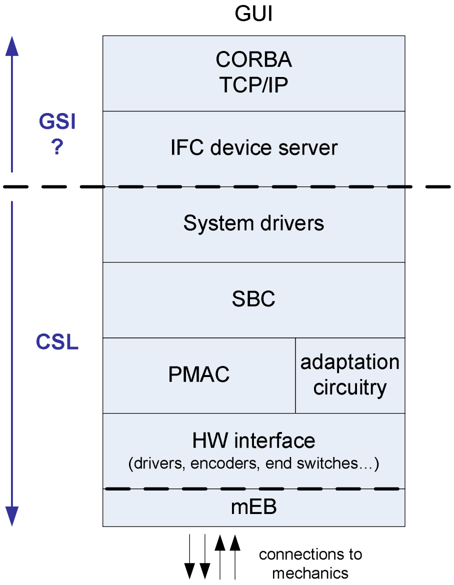


Figure 2 – system specification for a motion-control system

2. HW REQUIREMENTS

2.1. STEPPER MOTORS

Home-running (reference movement) at the startup is not possible/permitted (interference with the beam is not allowed), therefore absolute-position encoders are provided (see sect. 2.4), which provide a reference point at the power-up. Stepping motor must be kept at the system power-up position and must not be moved.

The system will support 5-phase stepper motors (or compatible, see below), which can or can not be equipped with a motor brake (the brake-release connection can be simply left out). Example motor specification is given in [2].

Motors are normally driven full-step and rarely half-step, but this is the feature of the motor drive.

Motors to be controlled by the microIOC-M-Box-PMAC can be of any kind, as long as they can be controlled by the motor drive, whose interface is compatible with motor drive specified in sect. 2.2 and requires compatible brake handling scheme.
It is assumed that suitable combination of motors and motor-drives is provided to get the adequate level of torque, acceleration and speed.

2.1.1. Acceleration/deceleration

In normal usage, motor control must support the acceleration and deceleration curve. Also when homing, the deceleration curve must be minded and the motor should slowly decelerate when the arrival to the end switch is expected (but the limit switch must still be touched).

2.1.2. Amplifier disable & brake

It is required that motor-drives are not powered when the motors are not moving (the current flowing through the stepper-motor windings and the motor-drive itself could interfere with measurements of the beam diagnostic equipment). When the motor-drive is not enabled, the brake should be on and vice-versa. The appropriate timing scheme should be applied for the windings off, brake and pulse signals

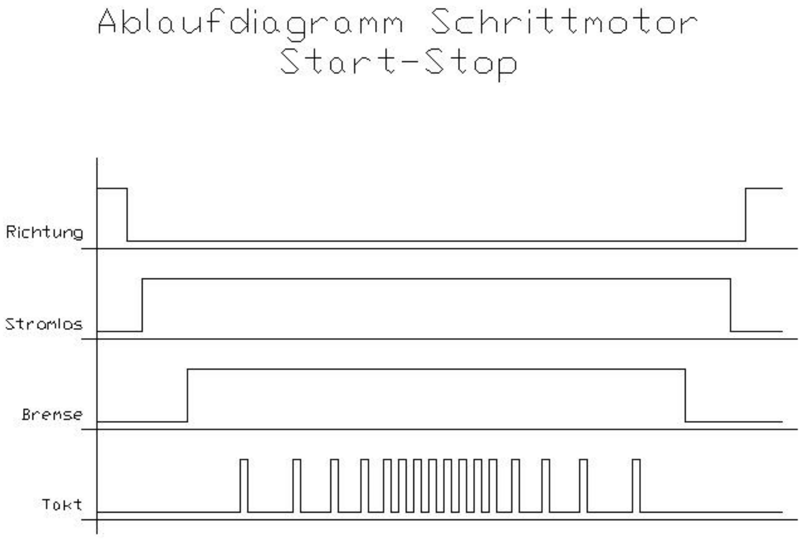


Figure 3 – motor-drive control and brake handling
(figure is only schematic and must be adapted to the specific motor driver device)

2.2. MOTOR DRIVES

The system will support **`Vexta CSD 5828 N-T`** motor drives or compatible. Interface for the motor drive is specified in [2].

Motor drives will be installed in mEB.

Full/half stepping - will be supported remotely from microIOC-M-Box-PMAC from SW.

Automatic current cutback enable/disable – will be configured by jumper/switch.

2.3. MOTOR BRAKES

Motors that are equipped with a brake require 24V power supply applied (11W/500mA) to release the brake. Brake power supply is not handled by the motor-drive itself, therefore it is necessary to add extra circuitry (i.e. motor-drives don't know anything about the brake). See also section 2.1.2.

Circuitry for handling motor brake will be installed in mEB.

2.4. POSITION ENCODERS

Only the radiation-resistant position encoders can be used inside the tunnel. Linear potentiometers have proved to be reliable in these heavy conditions.

Current GSI motor controller does not use the reed-back from the potentiometer (i.e. absolute position) as the position-correction feedback, but only for a visual feedback to the operator-person. The current usage scheme is as follows: 1) power up the device; 2) check the absolute position (potentiometer reed-back); 3) provide the desirable number of pulses[1] in specified direction; 4) check the absolute position again (if it has moved to the desirable position). So "called open-loop driving" is applied, where it is assumed that the stepper motor will move for the specified number of steps.

There are no incremental encoders used on GSI's systems at the moment. Closed-loop feedback is not possible and open-loop motor driving will be used with SW position correction if required.

The required precision is 0.1 mm for linear potentiometer or 0.3° for angle-measurement devices. If the precision of the measurement (position feedback) device is lower, the resultant precision is defined by that device[2].

Mechanisms, currently used in GSI in conjunction with linear potentiometer, do not provide satisfactory position read-back. If higher resolution is required, the absolute position read-back from linear potentiometer is used as a reference point from which incremental stepping is made – here without any feedback that stepper motors have actually moved. On a higher level control these relative movements are accumulated and regularly checked against expected position read-out value (i.e. checking if the read-out value is within anticipated position). In this way, a stepper motor is used as a measurement tool for resolution higher than that achievable by linear potentiometer.

Due to the very long required distance between microIOC-M-Box-PMAC and mEB, the position feedback will be realized by circuitry built within mEB, which will handle position feedback conversion into information suitable for digital transfer over RS-485 connection (back to the microIOC-M-Box-PMAC).

2.4.1. Linear potentiometer

Linear potentiometers with the resistance of 1kΩ~5kΩ and linearity position precision of 0.15% are generally used. Insertion device movement range is within 50-1000 mm. To measure the position, normally a 12-bit ADC is ok, but if longer potentiometer is used, 14-bit ADC is required (12-bit ADC would not provide adequate absolute position-resolution because of the length of the potentiometer).

Currently used operating principle is to apply a reference voltage to both end-sides of the potentiometer and measure the voltage on the slider connection.

Using a cable with length up to 60 meters there is a voltage drop on the line to the potentiometer. So there must be a way to set up the reference voltage or to adjust it in the SW settings. A coefficient in the device setup is required for this.

Robert Boywitt: *Usually we drive the device to zero position and then we set up the device to move, for example to position 100mm (the motor will do that), and check the reed back from the potentiometer. The missing distance is proportional to the voltage drop on the line. So now we can calculate.*

---

[1] The movement is specified by the number of pulses (i.e. relative from current position), and the current movement limitation (of the pulse-giver system) is 2^16 number of pulses (i.e. steps).

[2] In case of 1000mm linear potentiometer a 0.1mm absolute precision equals to 0.01% accuracy, which is not feasible to achieve by a 1000mm linear potentiometer that has defined linearity precision of 0.15%.

2.4.2. Rotary encoder

For some systems the absolute angular encoder TWK, CM-50-1024-G18-A01 (1024 pulses/rev, Gray code/18-bit) [1] should be supported. The encoder has parallel interface, which was successfully used over the 60m (with multiple GND wires to handle the GND-floating issues).

This type of encoder will not be used for the septum project.

2.5. POSITION SWITCHES

Only one types of position switch is used at GSI; simple cherry-like mechanical switch. The precision of these mechanical switches is 0.5mm. In/out-limit position switches are of type normally-closed (safety reasons, in case of disconnection) and touching switches must have programmable polarity.

Three position switches are used per motor axis; in (positive), out (negative) and "touching" switch. The later one is used in conjunction with two opposite-moving axes that could eventually hit each other. Usually if it is used in vacuum, only one wire is used (limiting the vacuum issues with the cable inlets).

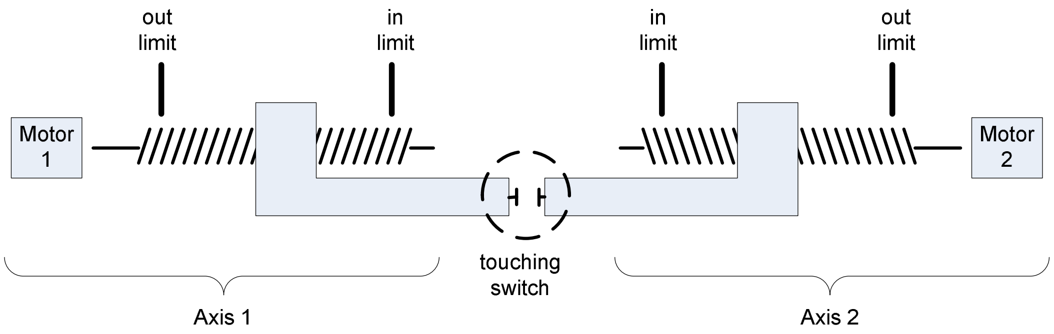


Figure 4 – out-limit, in-limit and touching switch

Switches are currently used with 5V power supply, but there is no limitation for 24V.

Safety feature
If any of the position switches are activated, the movement must stop immediately (i.e. without curve-deceleration).

Not all devices have limit switches; rotating/turning devices don't have limit switches. If required, SW limits must be set.

Position switches will be installed in mEB.

2.6. DEVICE MOVING OUTPUT SIGNAL

Every motor-channel must provide an output to signal that the motor is moving; often only one of several actuators, like stepping motors and compressed air actuators within one box can be allowed to move into the beam. Galvanic isolated programmable short-circuit/open contact is required.

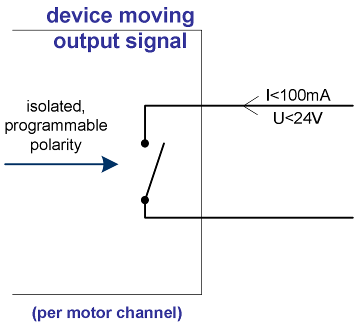


Figure 5 – axis moving output signal

This signal is available through the microIOC-M-Box-PMAC.

2.7. AXIS INTERLOCK INPUT SIGNAL

Every motor-channel must have an interlock input, which, if active, stops the movement of that axis immediately. Galvanic isolated programmable detection of external short-circuit/open connection is required.

Because large distances are required 24V power supply is recommend for this switching (i.e. external device should be capable of short-connecting a 24V). In GSI there were some problems using 5V power supply over long wires, therefore 24V is preferred.

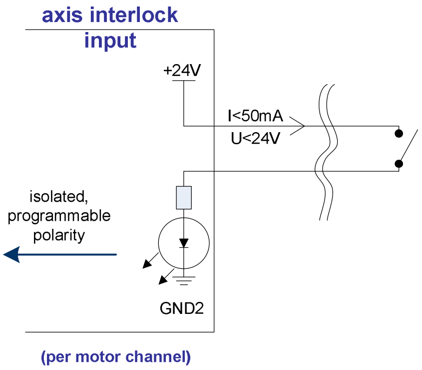


Figure 6 – axis interlock input signal

This signal is available through mEB.

2.8. AXIS INTERLOCK OUTPUT SIGNAL

Every motor-channel must have an interlock output to provide the means of disabling/blocking the movement of other devices; often only one of several actuators, like stepping motors and compressed air actuators within one box can be allowed to move into the beam. Galvanic isolated programmable short-circuit/open contact is required.

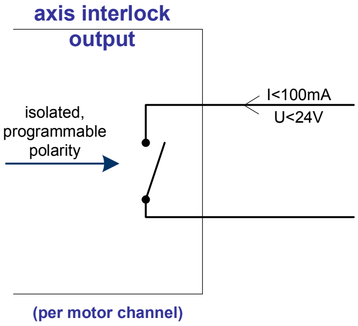


Figure 7 – axis interlock output signal

This signal is available through mEB.

2.9. FRONT PANEL DISPLAY AND CONTROLS

This information should be available at the front panel (per channel):

- positive limit active/inactive
- negative limit active/inactive
- middle (touching switch) active/inactive
- interlock status (input) active/inactive
- absolute position (showing also the name of the device, 8 characters)

Figure 8 – LCD 16x2 character display

1	_	_	_	_		2	_	_	_	_					
3	_	_	_	_		4	_	_	_	_					

Figure 9 – display example, all channels visible, no signal active

1	P	_	_	_		2	_	N	_	_					
3	_	_	M	_		4	_	_	_	I					

Figure 10 – display example, ch.1: active positive limit, ch.2: active negative limit, ch.3: active middle switch, ch.4: active interlock input

LCD 16x2 character display with 5 SW programmable keys (Up, Down, ESC, Enter, Fn) will be used. Figure 9 and Figure 10 show example how different conditions can be visible for fast supervision.

```
channel0: 123,45
channel1: 678,90
```

Figure 11 – display example, showing 2 channels (name and position)

```
m.move channel0 
    1234,56     
```

Figure 12 – display example, issuing manual move of channel0

The size of a display is also adequate for displaying a position for a pair of axes (using 8-characters long name and the position). Low-level single axis position adjustment will be also provided through this interface (i.e. the channel will be selected and move will be issued).

2.10. POSITIONING, TUNNEL, DISTANCES

The radiation damage should be taken into account, which is the primary reason for allowing the 60 m distance between the mEB and the controlled mechanics.

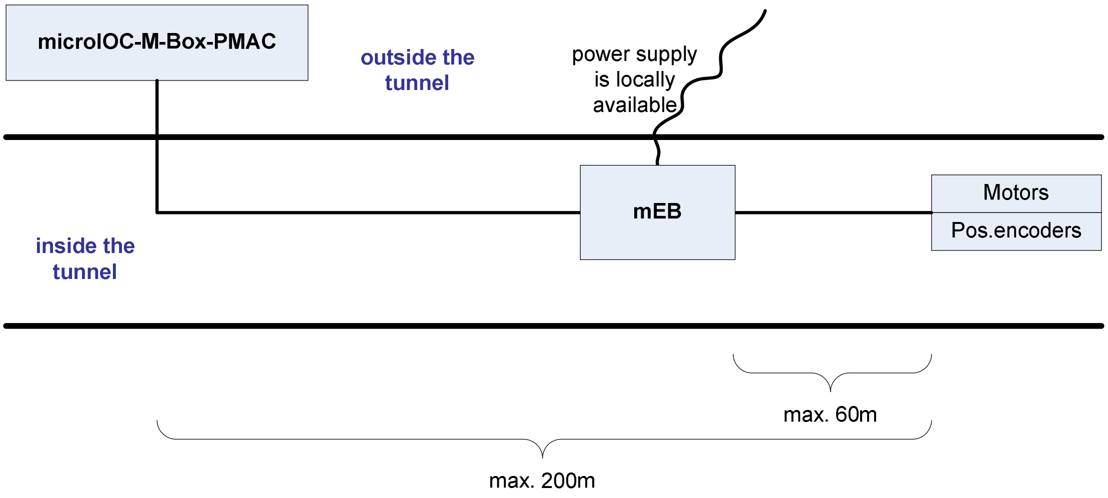


Figure 13 – cable length and positioning regarding the tunnel

When the distance between motor-drives and the motors was increased to 60m, the pulse frequency for the motor-drives had to be reduced to 500~2 kHz.

Power supply will be available near the mEB.

2.11. BACK-PANEL CONNECTORS

Preferred connection cable between microIOC-M-Box-PMAC and mEB should have both sides identical, with 1-to-1 wiring (to eliminate potential cabling/connecting mistakes).

Connectors for connecting to the existing GSI systems are specified in sect. 6, Appendix – connectors.

2.12. POWER SUPPLY

Currently in GSI they use 10A/24 power supply for powering motor drives (but using multiplexing, i.e. not powering more than single motor drive at one time).

Power supply will have to be provided within mEB (adequate for supplying required number of motor drives and accompanying electronics).

3. USAGE SCENARIOS

3.1. SEPTUM

The electrostatic septum that will be controlled with the microIOC-M-Box-PMAC will serve for the purpose of injection of the beam into the storage ring. The septum device can be described as a two-plate capacitor (anode and cathode), having the movement range of 30 mm and applied voltages of 300 kV. One part of the septum is simple plate; the other resembles U-shape with the covering at the top. It is in-vacuum device (10^{-11} mbar). Each plate of the septum is controlled by two motorized axis. Beam profile monitor will be installed after the septum to measure the losses of the beam (dependant upon several parameters).

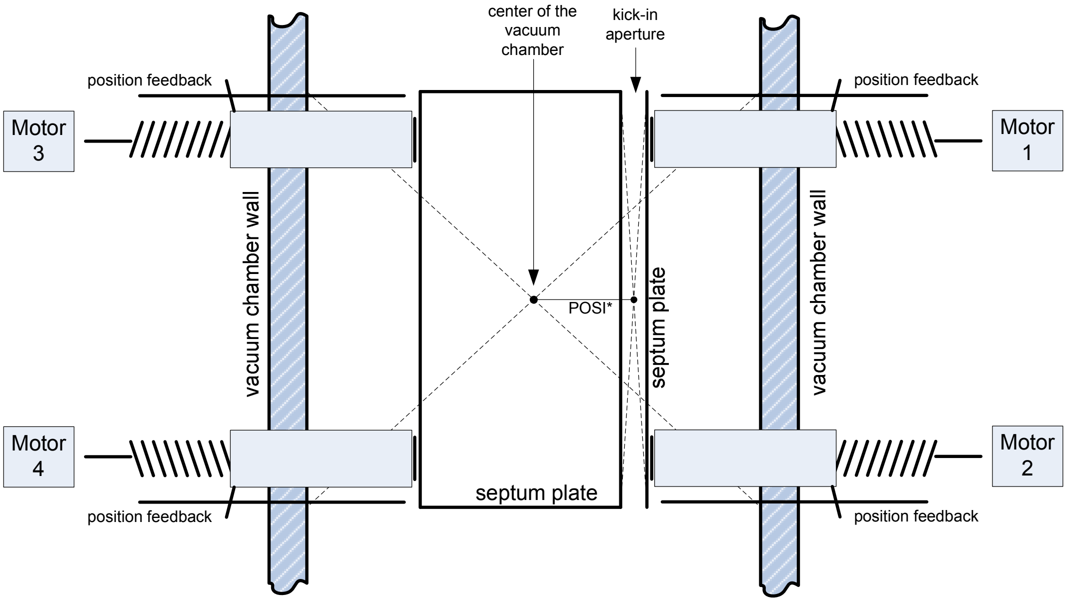


Figure 14 – septum schematic representation

POSI* - reference point for the joint movement of both plates relative to the vacuum chamber (plate gap unchanged; property POSI) - there is always a certain distance between the center of the vacuum chamber and the plate reference point.

Two types of movement are required:

- movement relative to the vacuum chamber where the gap between both plates remains unchanged (i.e. synchronous movement of all 4 axes).
- movement where the gap between both plates is changing (i.e. 2/4 axes move)

All 4 axis provide position feedback using linear potentiometer (the type similar, but no the same, to CLP 30-200S, DL 025.000.060, CLP30-200/6447, Fa. Megatron).

Only small inclination is allowed for both plates (preferably 0) – i.e. the pair of motors, moving the same plate, should move at all times in parallel. Maximum differentiation for driving-spindle pair should be kept below 2~3 mm.

Because of the sensitive mechanics, the forces on the mechanics should be minimized – maximum speed should be limited to 1mm/sec and also S-curve acceleration should be applied (PMAC).

If the feedback positions of two parallel axes differentiate then the microIOC-M-Box-PMAC should correct the difference. Maximum movement speed at which SW position correction could be still applied will depend on the several factors constituting drive/read-back loop. This shall be checked and later agreed.

Absolute precision of the entire system should be 0.1 mm. **The mounting of the mechanics including linear potentiometer will be done in such way that potentiometer readouts will provide completely adequate determination of the absolute position.**

No limit switches are provided, all the protection should be done in SW.

Figure 14 shows the center of the vacuum chamber and the center of the septum device. Reference coordinate system for specifying the movements will be defined later.

Movement of the septum plates will be done rarely and not dependant on the virtual-accelerator settings.

Mechanics: spindle – 5 mm/rev, motors – 500 pulses/revolution, gear ratio - 2:1

Responsible person for the septum project is Udo Blell (availability should be checked, because of the planned vacations, May).

Robert Boywitt: *The potentiometers of the Septum are distributed bye Megatron Type CFL, see the link below.*

http://www.megatron.de/Wegsensoren/Ubersicht_potentiom_/ubersicht_potentiom_.html

3.2. SLIT SYSTEM

Bottom picture shows the example of the slit system, showing much of the parts also used in other systems (stepper motor, spindle, linear potentiometer, end switches). This system uses Berger Lahr 5-phase stepper motor (Berger Lahr does not make them anymore) with the brake (release when power applied, 24V, 11W). Linear potentiometer specifications are 1kΩ, 0.15% linear precision.

Figure 15 – slit system (stepper motor, spindle, linear potentiometer, end switches)

3.3. COLLIMATOR SYSTEM

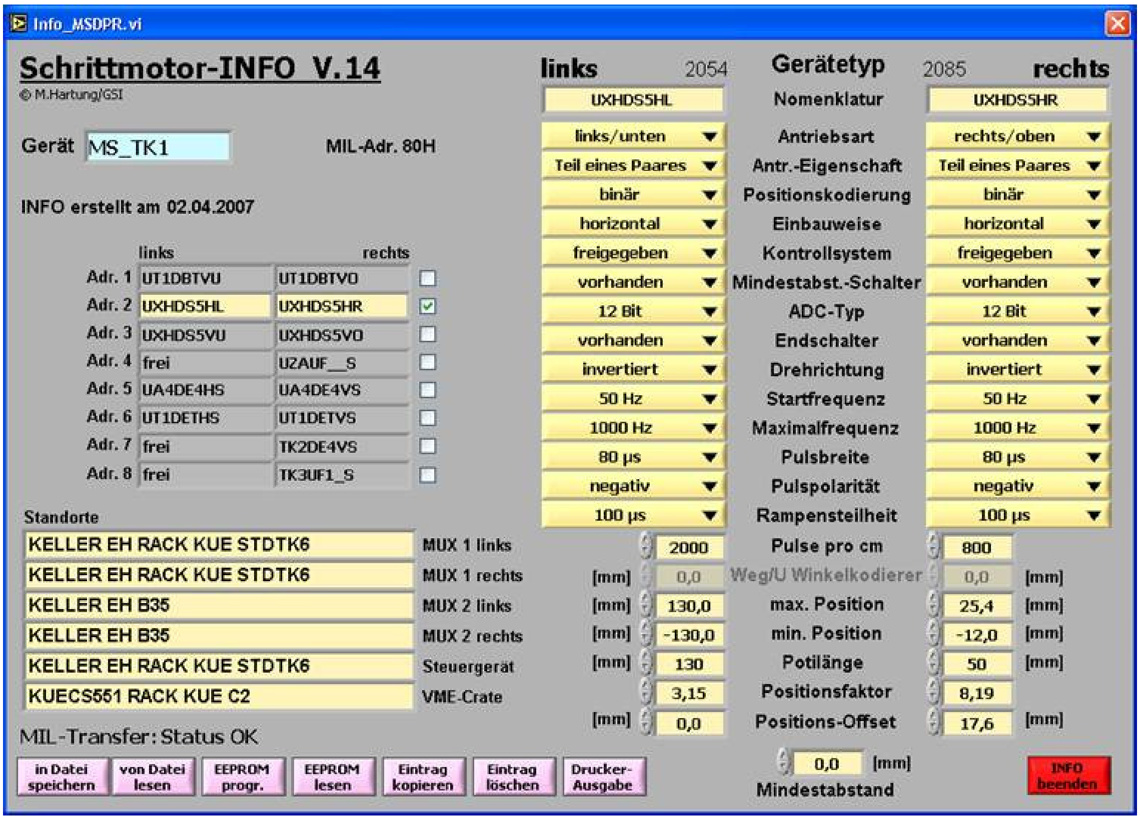
This is some other project that could eventually be controlled using microIOC-M-Box-PMAC. Installed at the winter shutdown, movement: 10mm/sec, single axis. Alternative is to use PowerPC as SC (supervising control) and M68k as EQ (equipment control).

4. SW SPECIFICATIONS

microIOC-M-Box-PMAC is booting from local FLASH memory card. If required, additional configuration could be made that would enable boot over Ethernet. microIOC-M-Box-PMAC contains Linux Debian. NFS, SSH and other standard Linux network features are available.

4.1. EXISTING LOW-LEVEL CONFIGURATION AND TEST SW

Currently a SW is available that enables low level configuration of the mechanical aspects of the device (pulses per mm, direction of movement, name for the motors, position read-back, etc.). The configuration settings are permanently stored in the motor-controller unit. This information is used also by **DevMan** (device manager) at the instantiation of the device CORBA object to provide required translation of control-system calls into understandable commands for equipment control.



Schrittmotor-INFO V.14

© M.Hartung/GSI

Gerät MS_TK1

MIL-Adr. 80H

INFO erstellt am 02.04.2007

	links	rechts	
Adr. 1	UT1DBTVU	UT1DBTVO	☐
Adr. 2	UXHDS5HL	UXHDS5HR	☑
Adr. 3	UXHDS5VU	UXHDS5VO	☐
Adr. 4	frei	UZAUF__S	☐
Adr. 5	UA4DE4HS	UA4DE4VS	☐
Adr. 6	UT1DETHS	UT1DETVS	☐
Adr. 7	frei	TK2DE4VS	☐
Adr. 8	frei	TK3UF1_S	☐

Standorte

KELLER EH RACK KUE STDTK6	MUX 1 links
KELLER EH RACK KUE STDTK6	MUX 1 rechts
KELLER EH B35	MUX 2 links
KELLER EH B35	MUX 2 rechts
KELLER EH RACK KUE STDTK6	Steuergerät
KUECS551 RACK KUE C2	VME-Crate

MIL-Transfer: Status OK

links 2054	Gerätetyp	2085 rechts
UXHDS5HL	Nomenklatur	UXHDS5HR
links/unten	Antriebsart	rechts/oben
Teil eines Paares	Antr.-Eigenschaft	Teil eines Paares
binär	Positionskodierung	binär
horizontal	Einbauweise	horizontal
freigegeben	Kontrollsystem	freigegeben
vorhanden	Mindestabst.-Schalter	vorhanden
12 Bit	ADC-Typ	12 Bit
vorhanden	Endschalter	vorhanden
invertiert	Drehrichtung	invertiert
50 Hz	Startfrequenz	50 Hz
1000 Hz	Maximalfrequenz	1000 Hz
80 µs	Pulsbreite	80 µs
negativ	Pulspolarität	negativ
100 µs	Rampensteilheit	100 µs
2000	Pulse pro cm	800
[mm] 0,0	Weg/U Winkelkodierer	0,0 [mm]
[mm] 130,0	max. Position	25,4 [mm]
[mm] -130,0	min. Position	-12,0 [mm]
[mm] 130	Potilänge	50 [mm]
3,15	Positionsfaktor	8,19
[mm] 0,0	Positions-Offset	17,6 [mm]

0,0 [mm]
Mindestabstand

Figure 16 – screenshot of the current low-level configuration SW

Various setting can be made; such as name of the motors, type of the ADC (reading voltage from the position potentiometer), +/- directions, gear ratios, number of pulses/mm, limit positions, etc.

4.2. SYSTEM DRIVER

Cosylab will provide microIOC-M-Box-PMAC with system driver, which will enable controlling PMAC and other microIOC functions trough C++ programmable API. Driver will enable program functionality which is required by GSI device model given in outline [4] and in next section.

System driver will make possible implementation of device properties and commands by calling one or several driver commands. Driver will not prevent any movement and will send all commands to PMAC without checking. All value checks must be done by device model. Purpose is that driver will expose PMAC controls and will execute commands exactly as ordered and any logic, which is not part of PMAC functionality, must be implemented in higher level controller, such as device model or server.

System driver will make possible to implement constraint by which plates will always move parallel.

4.3. CONTROL-SYSTEM DEVICE CONTROL

microIOC-M-Box-PMAC should run **`DevMan`** (device manager). **`DevMan`** (device manager) should instantiate so many CORBA objects as there are the number of controlled devices. In the case of the septum device only single CORBA object needs to bi instantiated (providing name of the device, equipment models, and device parameters (check for example Figure 16)).

Outline for the septum device equipment model is given in [4] - DSS means Diagnose Stepping-motor Septum (DS, Diagnose Stepping-motor, is GSI's standard equipment model for stepping motors.). This device equipment model represents the commands that could be issued from control system to the device. Three types of commands exist; read, write and call.

The command can be grouped in three types; generic device properties (required by device equipment model interface), high-level settings (that physicists are interested in) and not-so-high-level settings (for the mechanics debugging purposes; like issuing a direct move of a selected axis).

Below is list of device properties extracted from [4]:

- STATUS (read). Part of 32 bit status will be read from system driver.
- DISTI (read/write, set value, 1 float, in mm), DISTS (read, actual readback value, float, in mm). Separation of plates by movement of cathode plate. Anode remains fixed.
- POSIS (read/write, set value, 1 float, in mm), POSII (read, actual readback value, float, in mm). Position of center of two plates. Movement out: first moves outer plate then inner plate. Movement in: first moves inner plate then outer plate.
- PLATEINFO (read, set/actual value, 4 floats). This is combination of center position and plate separation.
- MOTPOSI (read, 1 float, in mm). Will return position of individual stepper motor. Input parameter 0 to 3 is number of motor for which value shall be returned. Intended for technical screens with position feedback.
- ADJUST (call). Set plates parallel by moving anode-motor at beam exit (only one motor). A purpose of this call is to re-adjusts plate positions after STEP function was issued.
- STOP (call). Stop all motors, cancel all movement. This is emergency about method.

- STEP (write, 1 integer, in mm). Data transferred is number of steps to be moved in or out. Additional parameter from 0 to 3 tells which motor to move. No position check foreseen, limited to max plates difference of 2~3 mm per call on device model side.

GSI:

If a difference from the desired position is discovered it should be corrected locally and not passed to control system (i.e. automatic position tracking, not manual).

Comment by Igor Kriznar:

regarding the equipment used this is not possible. Because of low precision of the position sensors any automatic closed loop would be dangerous. If there is to high difference between set position and actual measured position this situation must be available trough control system to an operator with additional warning signals.

Device manager will implement commands and properties by calling by Cosylab provided system driver for PMAC. Any software checks of values before they are applied to driver (and PMAC) will have to be implemented in device manager.

Contact persons for the control system integration are Klauda Herlo and Ludwig Hechler.

4.4. FRONT PANEL DISPLAY AND CONTROLS DRIVER

Front panel LCD display can be operated by issuing control characters to assigned RS232 port on microIOC. If LCD is used only to display device status and values then no special driver is necessary. If LCD is used for input of values then it is advisable to write driver for LCD display to automate LCD display input functions.

LCD operates with "pages". Each page displays different content or different values from device manager.

LCD controller is a process which operates LCD display by reading or writing values to device manager. LCD controller could be run as part of device manager or a process which is run on microIOC in parallel with device manager. In both cases LCD controller should use device manager function to read or write values because they implement software checks which prevent setting dangerous values. LCD controller is client process in regard to device manager.

5. MISCELLANEOUS

5.1. MAILING LIST

When staring a project Cosylab creates a mailing list with all the people involved in the project. The purpose of the list is to have open conversation regarding the project-related issues. Current list of people is:

- Robert Boywitt (electronics)
- Klaudia Herlo (control system SW)
- Ludwig Hechler (control system SW)
- Udo Blell (septum design)
- Ralph Bär (control group leader)
- Udo Krause (control system SW)
- Joze Dedic (HW)
- Igor Kriznar (SW)
- Peter Medvescek (PMAC SW)

5.2. TIME PLAN

Time plan needs to be detailed and agreed.

Week No.	Date of visit	Item
13 or 14	27.-30.3. or 2.-5.4.	2 persons to GSI to get requirements
15-16		Writing specs
17	23.-27.4.	Presenting specs at GSI
18		contingency (May 1st holidays)
19-22		Parallel development at Cosylab
23		Contingency for development
24-25		integration (combine PMAC driver, device server and GUI)
26-27		Tests & development at Cosylab
28		Contingency
29	16-20.7.	Installation and acceptance at GSI

Table 1 – draft time plan (by Mark Plesko)

5.2.1. Commissioning for a septum project

For Cosylab to make SAT in time, a working mechanics should be provided for a sufficient amount of time. In case of mechanical failures, Cosylab can not be held liable for not meeting agreed deadlines for system set-up.

Ralph Bär:
Date of first test installation.
Date of the final installation during the shut-down.

5.3. REPORT FROM APRIL VISIT TO GSI

Monday (2.4.07): discussion/information capturing with Robert Boywitt about the HW aspects of motion control system, draft document preparation (information captured in sections 1 and 2), arranged a meeting with Ludwig Hechler, Klaudia Herlo and Klaus Hoeppner for Tuesday 9.00.

Tuesday (3.4.07): meeting with Ludwig Hechler, Klauda Herlo, Klaus Hoeppner – control system SW. Later Udo Blell + 2 persons (PhD, collimator system) joined – explanation of the mechanics for the septum system. Document updating.

Wednesday (4.4.07): meeting with Robert Boywitt – discussing open issues, specifying connectors, etc. Document updating.

5.4. OPEN ISSUES

5.4.1. Equipment borrowing

For us it is very important to have at Cosylab the same (or conceptually similar) system that will be used on the final mechanics (motor, spindle, motor drive, potentiometer, end switches). To make as many tests as possible at our side, current practice is to have a **pair of motor drive, motors and encoders**. If no spare parts are available at GSI, for us an acceptable solution would be to buy the equivalent parts and sell it to GSI afterwards.

Would it be possible to borrow a slit-system, mentioned in 3.2? It features all the required components that would be required for the first proof-of-concept testing at Cosylab (i.e. power driver, motor connected to spindle and linear potentiometer.

Is there any other similar system available?

Robert Boywitt: *I would try to make a pair of drives available for you.*

5.4.2. microIOC

GSI can borrow microIOC from Cosylab in a short period if that would help SW people dealing with SW system, installed on the microIOC.

6. APPENDIX – CONNECTORS

6.1. MOTOR CONNECTOR

Distributor:	FCI/Burndy
Type:	UTG/UTP Bantam CAT. NR. UTG01412S

Contact	Signal
A	Phase W1
B	Phase W2
C	Phase W3
D	Phase W4
E	Phase W5
F	Phase W1/
G	Phase W2/
H	Phase W3/
J	Phase W4/
K	Phase W5/
L	Brake +
M	Brake GND

6.2. POTENTIOMETER AND LIMIT SWITCHES CONNECTOR

Distributor:	Provertha
Type:	9pol. D-SUB Socket, #ST0961G3

Contact	Signal
1	Limit Switch In
2	Touching Limit Switch
3	GND Limit Switch
4	Limit Switch Out
5	N.C.
6	U-Ref GND
7	Potentiometer slider
8	U-Ref +
9	N.C.

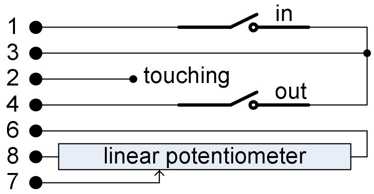


Figure 17 – potentiometer and limit switch connector

6.3. ABSOLUTE-ROTARY-ENCODER CONNECTOR

Distributor:	Provertha
Type:	25pol. D-SUB Socket, #ST2561G3

Contact	Signal
1	Bit 1 (LSB)
2 …17	Bit 2 … Bit 17
18	Bit 18 (MSB)
19	N.C.
20	Enable-Function (N.C.)
21	Code direction
22	digital GND (bit 1-18)
23	N.C.
24	power supply, VCC + 24 V
25	power supply, GND

6.4. INTERLOCK INPUT CONNECTOR

Distributor:	Lemo
Type:	Socket, ERA.OS.302.CLL

Contact	Signal
1	Interlock input
2	$\overline{\text{Interlock input}}$

6.5. DEVICE MOVING SIGNAL CONNECTOR

Distributor:	Lemo
Type:	Socket, ERA.OS.302.CLL

Contact	Signal
1	Device moving
2	$\overline{\text{Device moving}}$

6.6. INTERLOCK OUTPUT

Distributor:	Lemo
Type:	Socket, ERA.OS.302.CLL

Contact	Signal
1	Interlock output
2	$\overline{\text{Interlock ouput}}$