

# IKON19

## MOTION CONTROL & AUTOMATION REPORT FOR IKON19

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### 1. INTRODUCTION AND OVERVIEW

Most of the instruments are now in their different phases of detailed design or procurement and preparing for installation.

Besides reviewing the Motion Control & Automation Group (MCAG) is supporting the Instruments Projects with providing specifications for standard components and control electronics, coordinating the design of standardised software packages for the motion controller, designing standardised motion control cabinets and providing motion controllers to the partners for future factory acceptance tests.

The core of the design work has started since last IKON and relies to a large extend on two MCA in-kind packages with JCNS and a collaboration on low level control software with ISIS and JCNS.

Furthermore, MCAG is ramping up the provision of MCA engineering resources to instruments projects from design to commissioning. Agreements with three instruments teams and the associated recruitment of Engineers to the MCAG are on its way.

### 2. COMPONENTS STANDARDISATION

MCAG is supporting the design, commissioning and later maintainability of instruments by defining standard motion control components and electronics and issuing two respective documents:

- **ESS-0439471** MCA Components Standard (Preliminary; new document, supersedes ESS-ESS-0037290)
- **ESS-0365855** Motion Control EtherCAT Electronics Standard (Rev3; issued May 2020)

During the detailed design work, discussions with suppliers and first tests by JCNS the need for adaptations and corrections was identified. A new document for MCA components standard is currently prepared and will be issued as Rev1 shortly after IKON 19 (October 2020). In the meantime, instruments teams directly link to their MCAG contact for clarity and support.

### 3. MOTION CONTROL SOFTWARE COLLABORATION

<https://confluence.ess.lu.se/display/MCAG/TwinCAT+Working+Group>

Among other partner facilities ISIS and JCNS have decided to use the same hardware platform for motion control than ESS. In order to unify the structure and design of the control software TwinCAT, a collaboration was established between the three facilities, the TwinCAT Working Group. Several other facilities in and outside the ESS project joined the project as observers (LLB, HZG, Wigner, PSI, FRM-II/TUM, DESY/European XFEL, SLAC). A unified control rack (MCU 1024) with electronics and motion actuators was designed by MCAG, built by JCNS and delivered to the collaboration partners as a common test bed for the software development.

MCAG is collecting the ESS instruments requirements for low-level motion control and ensures the implementation in TwinCAT and connection to the top-layer EPICS control system. A first fully tested version adapted to ESS needs is scheduled to be deployed on a prototype motion control cabinet in Q1 2021.

### 4. MOTION CONTROL CRATES FOR FAT

<https://confluence.ess.lu.se/display/MCAG/MCU4004+-+19inch-4HU+basic+crate+for+motion+control+applications>

<https://confluence.ess.lu.se/display/MCAG/MCU0xxx+crate+modules>

MCAG has designed a set of motion controller crates (MCU 4004 + modules) for up to 4 axes control of small stepper (48V, < 5A) and servo motors at FATs of instruments components. 10 crates are currently under construction at the Electrical Workshop of FZ Juelich; 3 shall be ready to be deployed at the time of IKON (End Sept. 2020).

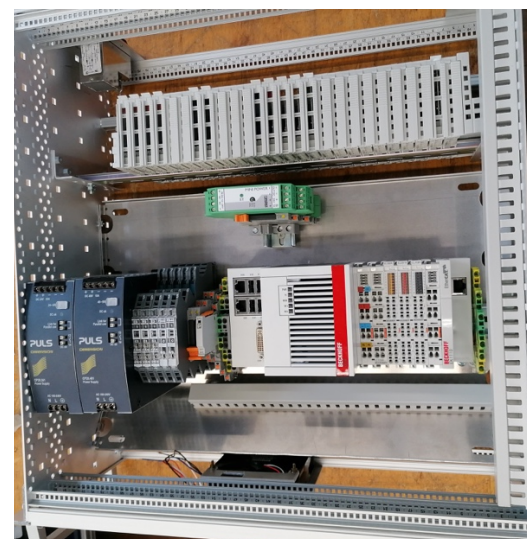


Figure 1: 4-Axes Motion Control Crate MCU 4004 for FAT

The design of another type of motion control crate (MCU 4005) for the test of large stepper motors (72V, >5 to 20A) is finalised and the components for 5 crates are procured. Production shall start in October 2020.

<https://confluence.ess.lu.se/display/MCAG/MCU4005+-+19inch-4HU+slave+crate+for+high+power+motors>

## 5. PROTOTYPE MOTION CONTROL CABINET

<https://confluence.ess.lu.se/display/MCAG/MCU5001+-+16+Ax+Control+Cabinet>

A 16-axes prototype motion control cabinet (MCU 5001) has been designed and built in Juelich (JCNS + Electrical Workshop of FZ Juelich). In its standard version it is designed to control 16 Axes of small (48V, < 5A) and large stepper motors (72V, 5 to 20A). Currently the cabinet is being commissioned at JCNS and shall be on its way to PSI at the time of IKON (End Sept. 2020) to be connected to and tested with the hardware of the ESTIA Selene Guide I.



Figure 2: 16-Axes Motion Control Cabinet MCU 5001

This prototype will serve as a template for all instruments projects from the hardware and electrical drawings (ePlan) point of view. Cabinet size and number of axes will stay the same; the type of motor, feedback and safety circuits can be customized. Pneumatic actuator control for instrument systems excluding shutter will be included in the future.

## 6. MOTION CONTROLLER FOR PNEUMATIC ACTUATORS

<https://confluence.ess.lu.se/display/MCAG/MCU+1031+-+Pneumatic+actuator+control>

Design has started for a lab control rack MCU 1031 with electronics and pneumatic actuators.

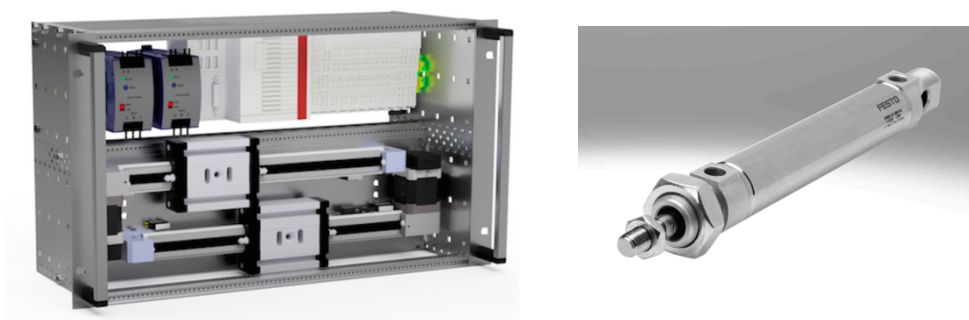


Figure 3: Test Motion Control Crate MCU 1024 + pneumatic actuator

It shall serve as a common test bed for the software development of motion control of pneumatic actuators including shutter control in the MCA lab and for the integration of pneumatic shutter control at the YMIR instrument in Utgard. Basis will be the crate MCU 1024 currently used as standard development platform in the TwinCAT Working Group. The linear tables with stepper motors will be replaced by pneumatic actuators and the electronics will be adapted accordingly. The design shall be finalised October 2020 and two crates built by December 2020. Test and commissioning are scheduled for January 2021.

## 7. MOTION CONTROLLER FOR SHUTTERS

<https://confluence.esss.lu.se/display/MCAG/Shutter+Motion+Control>

Heavy Shutter/Experimental shutter for instruments will be controlled by a dedicated motion control unit separated in hardware and space from the other motion axes of an instrument. It is very closely linked to the PSS system with some PSS components inside the actual MCA cabinet.

In most cases the actuator is a pneumatic cylinder. Solenoid valve and the compressed air supervision are therefore strongly linked to the control unit and may be located in the same cabinet.

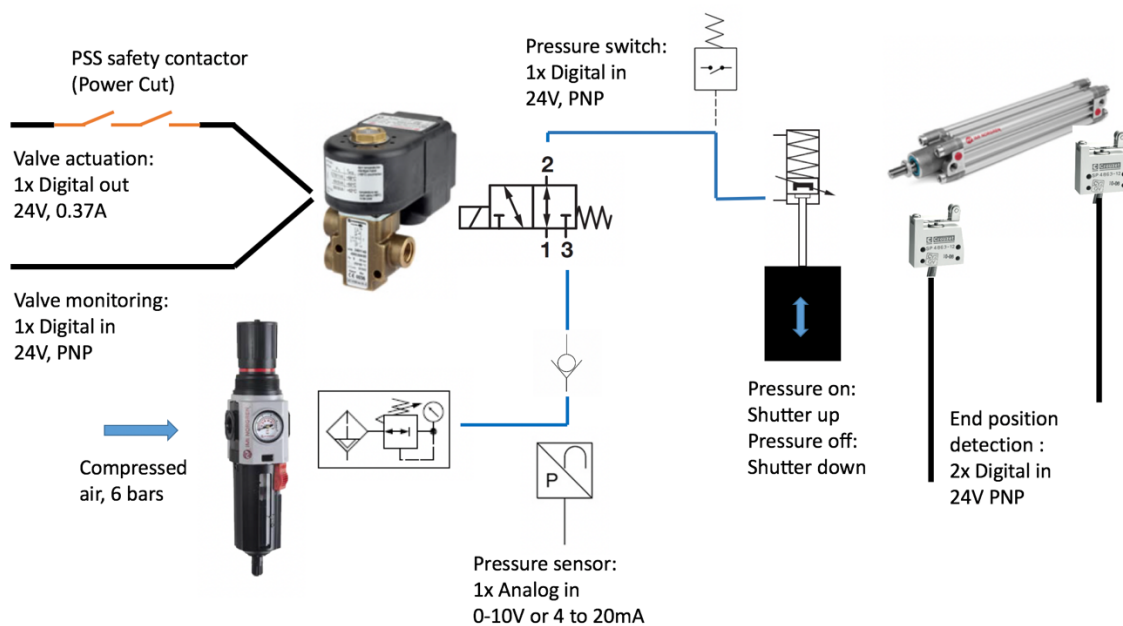


Figure 4: Proposed circuits for Pneumatic Shutter Control

MCAG is currently working on the concept and the interface definitions of that controller to PSS and to the Instruments Team responsible for the design of the mechanics and the pneumatic circuit. Milestones and timelines will be defined in the course of the MCU 1031 project.

## 8. MCA RESOURCES FOR INSTRUMENT PROJECTS

MCAG is offering the supply of engineering resources to those Instruments Teams without in-house capabilities or capacities. Possible tasks covered are defined in the document **ESS-2070580** - MCA Work Package Definition. Support for NMX and BIFROST has been ongoing since more than

two years; similar agreements with ODIN, CSPEC and LOKI are under discussion and shall be finalised in the next weeks.

Two engineer positions (3Y, time limited) have been opened at ESS to cover the need. First interviews have been conducted with a final selection of candidates expected in the next weeks. Starting dates are foreseen for the end of the year but might be a little bit delayed by Corona related issues.

## **9. SUMMARY AND CORONA IMPACT**

Standard specifications and soft-/hardware design are well on its way and will be deployed to the instrument teams in the next time according to the milestones above.

Hardware development including prototype building has considerably ramped up since the beginning of the year. In times of Corona most of the industrial supply chains are generally working well however a few key suppliers caused some delay time in the production of the controller hardware. For two product (Lemo connectors and Stoegra motors) we still investigate times of arrival. Urgent and early deliveries to in-kind partners are identified and discussed with the teams.

Prototype production had been done so far by the Electrical Workshop of FZ Juelich. For the building of the final cabinets customized to the different instruments we are currently evaluating commercial suppliers to support those Instruments projects without in-house construction capabilities.

For further questions and information please link to your contact partner in the MCAG.