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IOD – INDUSTRIAL OPPORTUNITY DAYS Torino, 12 – 13 giugno 2025

Opportunità nella meccatronica, elettronica e componentistica per acceleratori al CERN Salvatore Danzeca - CERN

> Opportunità nella meccatronica, elettronica e componentistica per acceleratori al CERN



Accelerator Systems & Beams Departments

The SY department is responsible for accelerator beam-related technical systems:

- Accelerator Beam Transfer;
- Beam Instrumentation;
- Electrical Power Converters;
- Radio Frequency Systems;
- Targets, Collimators and Absorbers.





The BE department is responsible for :

- Accelerator design, operation, and performance optimization;
- Accelerator control systems;
- Survey and alignment of accelerator components;
- Secondary beam lines and experimental areas across the CERN accelerator complex.





Sensors Acquisition & Motion Control (SAMbuCa)

Flexible and modular low-level control solution for mechatronics devices to provide a standard mechatronics control solution (i.e. standard HW building blocks & API) for the Accelerator Technology Sector



- ✓ Hard RT constraints → FPGA-based controllers
 - L timing synchronization (i.e. White Rabbit)
 - □ µs response time
- User friendly API to profit of all the hardware features



SAMbuCa architecture



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SAMbuCa: CERN Scope

LHC Collimator



NA absorbers



LHC crystal goniometer ELENA & AD scrapers Image: Comparison of the strategy o



NA collimators



ACTUATOR Stepper C brushed D brushiess AC brushiess Piezoelectric

ositioning sensors

terferometers imit switches device LHC collimator LHC goniometers NA absorbers NA collimators AD scraper

Target

ELENA scraper Etc.

Monitoring sensors LVDT 12PS emperature sensors



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REGIONE SAMbuCa: Actuators compatibility







SAMbuCa: Power Driver

https://indico.cern.ch/event/1115112/contributions/4688938/attachments/2376100/4058940/2022-01-20%20Motor%20Driver%20Overview%20SAMbuCa.pdf

Main features

- Robust and accurate control of stepper and DC brushed motors in constant current or speed control (including also AC and DC Brushless)
- Use over long distances with cable length compensation up to 1km
- standard stepping (open loop) or FOC (closed loop) control via the same interface and hot swappable
- Kalman Filter for position and torque estimation

Main specifications

- ✓ Control of 2 stepper motor or 4 DC brushed motors or 2 DC brushless
- ✓ Compact PCI serial rackable or standalone format
- ✓ Maximum current per phase: 10 A (rms)
- ✓ Maximum DC voltage: 170 V
- ✓ Communication interface: MODBUS over RS485, PROFINET, Standard stepper interface (STEP, DIRECTION, ENABLE)
- ✓ Supports up to 2 encoders
- \checkmark Current loop bandwidth up to 1 KHz



Driver prototype





OASIS overview and future needs

- A distributed oscilloscope application for operators and equipment experts
- 1500 signals acquired by 350 multiplexed digitisers. Using 370 trigger events
- Another 2200 signals from FGCs and 850 signals from other data sources
- Current systems based on Compact PCI and PCI
- Complete consolidation required by LS3 (2028) because of EoL of the installed digitizers





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OASIS: high-speed digitizers future tenders

Bits	Sampling Rate	Channels	Format	Quantity	Coupling and minimum bandwidth	Minimum Memory	Estimated Budget	Market survey by
8	1 GSPS	4	PXIe	140	DC50-400 MHz DC1M-300 MHz	1 GS per channel	>750kCHF, <5 MCHF	Q1 2026
10	2 GSPS	2	PXIe	35	DC50-1GHz	2 GS per channel	200k <c<750k< td=""><td>Q1 2026</td></c<750k<>	Q1 2026

Technical responsible:

Dimitris Lampridis dimitrios.lampridis@cern.ch



Opportunità nella meccatronica, elettronica e componentistica per acceleratori al CERN



Home · Wiki · Projects / White Rabbit · Open Hardware Repository (ohwr.org)

- White Rabbit provides sub-nanosecond accuracy and picoseconds precision of synchronization for large distributed systems (IEEE1588-2008)
- It allows precision time-tag measured data using the same network to transmit data
- It is foreseen to consolidate by 2028 all the CERN accelerator timing (i.e. Rs485 copper based) with WR

Quantity	ltem	Estimated Budget Range	Market survey by
100	WR switches v.4 https://ohwr.org/project/wr- switch-hw-v4/wikis/home	200k <c<750k< td=""><td>Q2 2026</td></c<750k<>	Q2 2026
1000	WREN Card	1MCHF	Q2 2026



www.white-rabbit.tech



Technical responsible: Evangelia Gousiou Evangelia.Gousiou@cern.ch







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Dry Storage Cabinets for storage of electronic components that will be tested for radiation tolerance and used for dedicated projects identified as Radiation Tolerant

Main characteristics:

- 4 or 6 doors
- ESD Cabinet
- Internal insulated capacity >1000L
- Remote Monitoring System
- Dryer Unit with adjustment range 0.5% RH ambient humidity
- Fast recovering when a door opens (<30min)
- Nitrogen Auto-Flow unit (The Nitrogen installation will be managed in a different contract)

Optional characteristics:

Data Logger

Technical responsible: Panagiotis Kalaitzidis panagiotis.kalaitzidis@cern.ch









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X-Ray Counter machine to count electronic parts during kitting preparation for electronic production and stock management

Main characteristics:

- Counting reels (7"-15"), tubes, cut strips, trays
- Counting inside ESD bags
- Barcode scanning camera
- Count accuracy: \geq 99.9 %
- Barcode printer

Optional characteristics:

- Counting of four 7" reels at once
- Combined X-Ray Inspection of assembled boards

Cost Estimation: 80-90K CHF

Technical responsible: Panagiotis Kalaitzidis panagiotis.kalaitzidis@cern.ch







Full Remote Alignment System (FRAS) project

https://indico.cern.ch/event/1079026/contributions/4544748/attachments/2330326/3972436/FRAS_HL_LHC_collaboration_meeting.pptx

- It consists of alignment systems (alignment sensors, motorized adapters, their acquisition and control/command systems, associated software) allowing to determine the position of components and readjust them remotely within a range of ± 2.5 mm
- All components from Q1 to Q5 (i.e. quadrupoles and dipoles magnets, collimators) in the LHC interaction points
- Installation and commissioning deadline: LS3 (end 2028)







Motorized jacks for quadrupole and dipoles equipped with 2 stepping motors (type 1)





Universal alignment platform to adjust remotely pitch, roll and yaw of the component on top – It is equipped with 5 stepping motors (type 2)



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work



FRAS project: price enquiries

Main competences:

- Epoxy Gluing and Potting
- Vacuum tests
- Fine mechanical machining
- Mechanical assemblies
- Functional test of mechanical equipment
- Electrode manufacturing
- Electronic soldering









Alignment sensors

Sensor Supports



Motoreducer assemblies



Price enquiries to be issued in 2025 (Cf. website of the CERN procurement service)

 Technical responsible:
 Mateusz Sosin

 Mateusz.Sosin@cern.ch



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Robotics related possible future procurements

- ROV with robotic arm
 - ✓ Minimum 6DoF
 - ✓ ~ 100 kg payload
 - ✓ Minimum speed 2km/h
 - ✓ Battery autonomy > 4hours
- ROV base only
 - ✓ Minimum speed 2km/h
 - ✓ Battery autonomy > 4hours

- Versatile legged and wheeled solutions to reach complicated zoned with robotic arm
 - ✓ ~ 10 kg payload
 - ✓ Minimum speed 2km/h
 - ✓ Battery autonomy > 3 hours

- Milling solution for big workspaces
 - ✓ Looking to improve our current in-house solution
 - ✓ Improve current repeatability as indicator value: 0.08-0.1 mm, according to ISO 9283 (max payload).





















The <u>ABT group</u> future needs for injection and extraction related equipment and beam-transfer systems:

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- Ceramic components (Al₂O₃)
 - -Important need for need for coating (Cr_2O_3) and machining of ceramic components.
 - -High tolerances rectified ceramic UHV spacers.
- Coating of laminated steel
- Stainless-steel and copper high precision mechanical component (some for UHV)
- > UHV stainless steel vacuum vessels
- Copper busbar manufacture







Accelerator Beam Transfer Future Needs

The <u>ABT group</u> future needs for injection and extraction related equipment and beam-transfer systems:

- Electrical / mechanical cabinet production
- > High power feedthroughs
 - Copper and stainless-steel, vacuum brazing, TIG welding, test 10kV, 35 kA, 20 bar cooling.
- Solid state power switches with very high di/dt and fast rise time >10kA/µs and 50 ns
- ightarrow 80kV / 25 Ω coaxial cables
- > Thyratron HV switches









Beam Instrumentation Future Needs

The <u>BI Group</u> future needs for instruments that allow observation of the particle beams and the measurement of related parameters:

- Stainless-steel and copper high precision mechanical component for UHV
- Production of an electron gun and collector at 80kV
- Specific cables and Radio-Frequency (RF) components
- Carbon NanoTubes wires









The <u>BI Group</u> future needs for instruments that allow observation of the particle beams and the measurement of related parameters:

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- Custom, radiation-tolerant, electronic boards
- DAQ electronic board using standard VME platform
- The production of mini racks for installation in tunnel
- Production of ionization chambers











Electrical Power Converters Future Needs

Be part of North Area Consolidation Project and HL-LHC upgrade

Design, Manufacture & Test build-to-spec equipment



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Power Resistors

MV transformers

Energy storage modules















Be part of North Area Consolidation Project and HL-LHC upgrade

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Manufacture & Test build-to-print equipment

Power Modules



Integration / Cabling







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Radio Frequency Present Needs

Tendering in preparation:

- MS-5089: 45 MW S-band RFpower source and two Xband power sources (25 and 50 MW).
- MS-5065: 400.8 MHz, 400 kW **CW**, Waveguide Junction **Circulators and Ferrite** Loads for HL-LHC.
- > MS-5030: 400.8 MHz circulators (50 kW CW, 100 kW pulsed)
- MS-5024:20 transmitters for >the High-Power RF systems of the HL-LHC, (400 MHz, 50 kW CW, 100 kW pulsed).











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REGIONE Radio Frequency Future Needs

The RF Group future needs for the CERN's RF systems that accelerate the beams:

- For R&D looking for ways to manufacture seamless copper cavities
- > uTCA based systems will be needed over the next decade and slowly replace existing VME systems
- For the existing RF amplifiers, there will be small-scale purchases of solids state and IOT based amplifiers







Sources, Targets and Interactions Future Needs

The <u>STI Group</u> future needs for equipment used for interaction of beams with matter to a large spectrum of activities:

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- Graphite materials (densities from 1.1 to 1.8 g/cm³) for the HL-LHC beam dump.
- Refractory metals (Ta, W, Ir, Nb)
- Various raw materials for the HL-LHC collimator (stainless steel, bearings, roller screws, etc.)
- High precision UHV tanks in stainless steel, aluminium and TiGr₅

Ongoing market surveys:

- MS-5036/SY/HL/LHC, supply of 44 seamless cylindrical Ti Grade 5;
- MS-4858/SY/HL/LHC, supply of Carbon Fiber reinforced carbon plates;
- MS-4857/SY/HL/LHC, supply of isostatic graphite blocks;

Upcoming ones:

- Ti-Sapphire pump lasers and laser pulse compressors;
- Gray Perlite Cast Iron GG20 (EN-GJL-200) supply (few MCHF worth)
- > Hot rolled pure W supply (around 1 MCHF worth)









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Forthcoming Tendering

Forthcoming Tendering Procedures

Please visit this page to check on ongoing and upcoming tendering (4 ongoing for the SY department, 16 more to come in the coming months)

If you would like t the related docun email to the email	o know more at nent under "Ava address depicte	out a specific procedure ilable action". However, d in the same section.	; please, click on one of the following procedures. In case y if the Market Survey documents have not been released y	you are intereste yet, you are invit	d in a specific Marke ed to express your ir	Survey, you will fin iterest by sending a
Firms may reply a disregard the date	as long as the t on the cover le	endering procedures are tter but please send your	e still on this page. Therefore, in case the deadline for re reply to the Market Survey as soon as you can.	plies indicated i	n the Market Survey	cover letter is ove
If you have any qu	estions, please a	ddress them to procurer	nent.service@cern.ch or to the procurement or technical o	fficers in charge o	of the corresponding	market survey.
Finally, we invite y	ou to consult th	is page frequently as the	status of each procedure is regularly updated.			
Type keywords	e.g. Magnets, So	ftware, Civil Engineering	200k 400k Cost Range (CHF) 0	1.5M	5M 10	M
			More Filters	Sha	re Search Results	Reset Filters
Publication date	Type of contract	Reference	Description	Cost Range (CHF)	Status	Next step
22/05/2025	Supply	IT-5114/TE	Supply of ten magnets for the north area renovation.	1.5M - 5M	Announcement	Invitation to Tender 07/202
22/05/2025	Supply	DO-34754/EN	Design, supply and installation of 18 kV busbar system.	200k - 400k	Announcement	Price Enquiry 06/2025
20/05/2025	Supply	MS-5104/SCE	Civil engineering works for the execution design and construction of Building 140 on the Swiss part of CERN's Meyrin site.	> 10M	Announcement	Market Survey 05/2025
20/05/2025	Supply	MS-5070/SCE	Civil engineering works for construction of a retention basin on the Swiss part of CERNs Meyrin site.	400k - 1.5M	Announcement	Market Survey 05/2025
20/05/2025	Supply	MS-5113/EN	Supply of ventilations systems on the CERN Site.	> 10M	Announcement	Market Survey 09/2025
20/05/2025	Supply	DO-34739/TE/CRG	Overhaul of 75 low-voltage (400 V) and 70 medium- voltage (3.3 kV) electric motors in accordance with IEC 60034 standards	200k - 400k	Announcement	Price Enquiry 10/2025
19/05/2025	Supply	MS-5106/SY	Supply of six oil tanks for the installation of high- voltage inductors, intended for outdoor operation.	400k - 1.5M	Announcement	Market Survey 06/2025
19/05/2025	Supply	MS-5105/SCE	Supply of Personal Protective Equipment (PPE), including protective clothing, with PunchOut	1.5M - 5M	Announcement	Market Survey

integration and support services





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Many thanks!

