EUROPEAN XFEL PHASE SHIFTER: PC-BASED CONTROL SYSTEM

E. Molina Marinas #, J.M. Cela-Ruiz, J. de la Gama, A. Guirao, L.M. Martínez Fresno, I. Moya, A.L. Pardillo, S. Sanz, C. Vázquez.
CIEMAT, Madrid, Spain

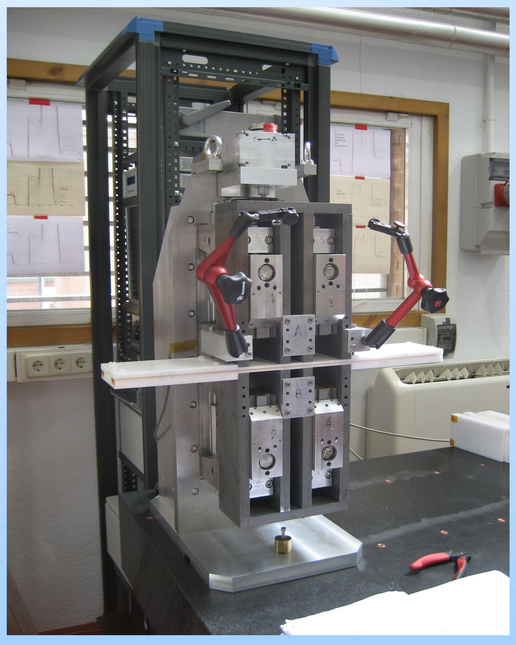
Abstract

The Accelerator Technology Unit at CIEMAT is in charge of part of the Spanish contribution to the European X-Ray Free-Electron Laser (EXFEL). This paper presents the control system of the Phase Shifter (PS), a beam phase corrector magnet that will be installed in the intersections of the SASE undulator system.

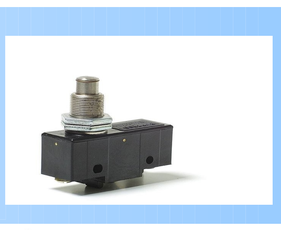
Beckhoff has been chosen by EXFEL as its main supplier for the industrial control systems. Beckhoff Twincat PLC architecture is a PC-based control technology built over EtherCAT, a real-time Ethernet fieldbus. The PS is operated with a stepper motor, its position is monitored by an incremental encoder, and it is controlled by a Twincat-PLC program using the TcMC2 library, an implementation of the PLCopen Motion Control specification. A GUI has been developed in LabVIEW instead of using Beckhoff visualization tool.

The control system for the first and second prototype devices has been developed in-house using COTS hardware and software. Specifications request a repeatability of ±50μm in bidirectional movements and ±10μm in unidirectional movements. The second prototype can reach speeds up to 15 mm/s.

PHASE SHIFTER

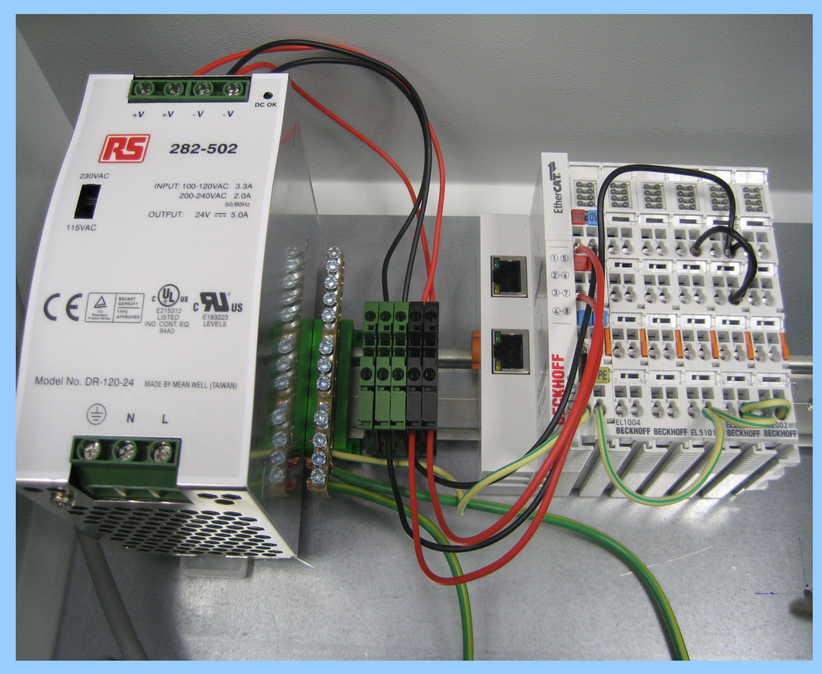


COMPONENTS



Motor, driver, switches, encoder

CONTROL HW



Power supply, PLC modules

HW configuration

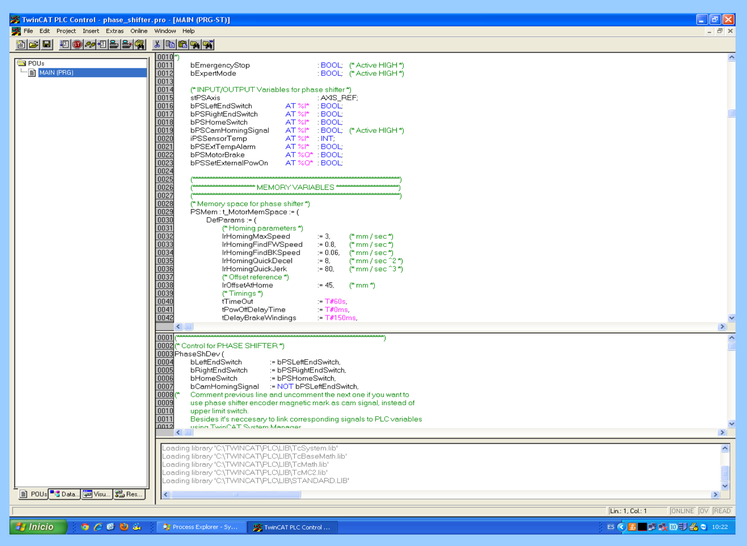
PS DEVICE

Characteristics
Parameters

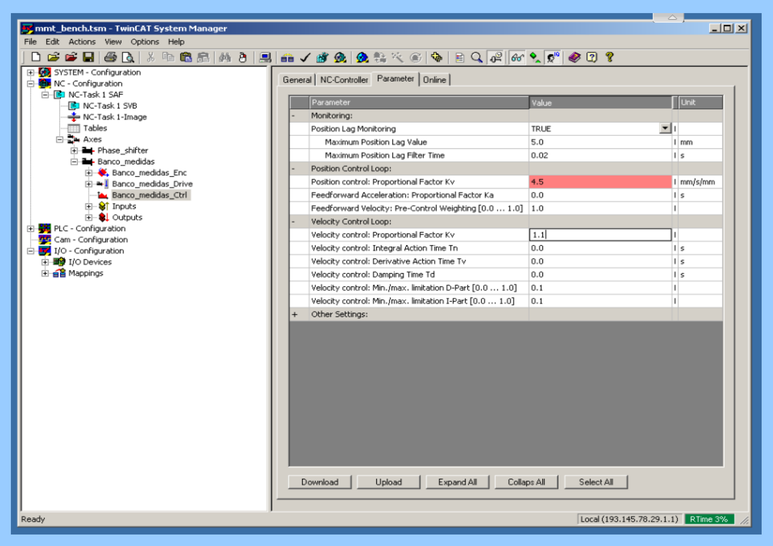
MOTORCOMMON.LIB
Developed in-house
for EXFEL project.
Based on TwinCAT MC2

CODE

SW Modelization

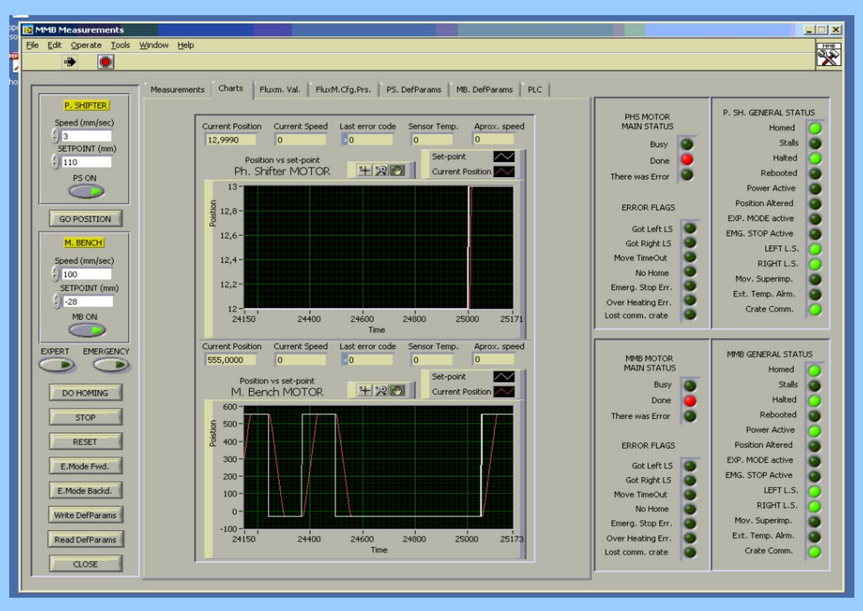


TwinCAT PLC: Programming tool



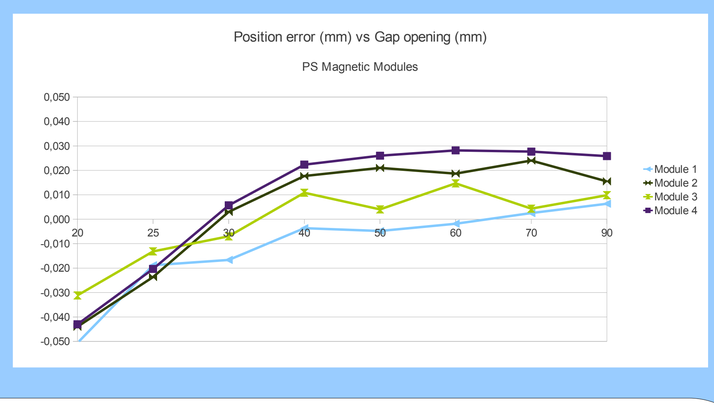
TwinCAT System Manager: Configuration tool

LabVIEW GUI



The LabVIEW GUI communicates with the PLC using an in-house developed library based on Beckhoff TcADSDll.dll

Preliminary Measurements



CONCLUSION

The Accelerator Technology Unit at CIEMAT is in charge of the design, manufacturing and delivery of several components to be installed in the 92 intersections of the Undulators System of the European XFEL, in particular, the Phase Shifter, the Quadrupole Mover and the Intersection Control Rack. All the control hardware has been implemented using commercial devices. In addition we have written a Beckhoff Twincat PLC library to encapsulate all devices as CNC axes within the Beckhoff architecture. GUIs have been created, based on an in-house developed LabVIEW library, able to communicate with the PLC runtime. As soon as the different prototypes have been available for testing in our labs, the integration of the control system has been quickly achieved. A fully automatic measurement procedure have been implemented. The first prototype achieved a repeatability of ±50μm, over the limit. The second prototype is now being tuned and preliminary measurements have been satisfactory.

ACKNOWLEDGEMENTS

This work is supported by the CIEMAT and the Spanish Ministry of Science and Innovation under SEI Resolution of September 17th, 2009. The authors would like to express their gratitude to our colleagues at E-XFEL, mainly J. Pflüger and S. Karabekyan, for their encouragement and support during this project.

*Work partially supported by the Spanish Ministry of Science and Innovation under SEI Resolution on 17-September-2009
eduardo.molina@ciemat.es

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN
Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas