Integrating Siemens Programmable Logic Controller with the Experimental Physics and Industrial Control System

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This note presents an overview of the software required to interface a Siemens Programmable Logic Controller (PLC) with Experimental Physics and Industrial Control System (EPICS) and details of a development test station to evaluate the implementation of the software.

The instrumentation and controls (I&C) for the Hall A Møller magnets are being developed and components are being evaluated. The Siemens S7-1500 series PLC of the I&C will interface between the sensors and magnet power supplies. The EPICS driver to interface with Siemens PLC, s7NODAVE, was developed by aquenos GmbH. The s7NODAVE driver was based on the LIBNODAVE library; however, due to bugs in this library, specifically with newer PLC controllers, the driver was changed to use the SNAP7 library. For EPICS to use this driver, it needs to be compiled, which in turn requires the ASYN driver (which provides asynchronous driver support), which itself needs EPICS base. The PLC controller is directly connected to a Windows computer (as the Siemens software only runs under Windows), which means that for this test stand, EPICS needs to run on Windows.

Since no binary releases are available for Windows, the EPICS related software would need to be compiled for Windows. Due to compilation issues unique to the specific build chosen, the solution selected was to use the Windows Subsystem for Linux 2 (WSL 2), which allowed a Linux environment to be run under Windows without a Virtual Machine or dual booting.

After the needed EPICS software was compiled, a softIOC was created to test communication between the PLC and EP-ICS via process variables (PVs). The first test of the softIOC was unsuccessful since some of the access settings on the PLC controller needed to be changed from their default settings, namely enabling the GET/PUT communication, Fig. 1, since only global data blocks can be accessed, optimized block access must be disabled, access level must be set to full access, and permit access with GET/PUT must be enabled.

After the PLC settings were changed to match the requirements for the included SNAP7 library, manually communicating with a PV using the caget/caput/camonitor commands indicated PVs communicating successfully with the PLC tags. To more easily view the values of the PVs, a CSS Phoebus screen was created to monitor the PVs, Fig. 2.

EPICS base and Siemens PLC were successfully compiled and configured to support communication via Ethernet between a Phoebus screen and a controller. This proof of principle gives confidence that the Siemens hardware can be integrated into the existing EPICS software infrastructure.

 General 							
Fail-safe	Access level		A	cess		Access	
PROFINET interface [X1]		HMI	Read	Write	Fail-safe	Password	
 PROFINET interface [X2] 	Full access incl. fail-safe (no protection)	~	~	~	~		
Startup	Full access (no protection)	~	~	~			
Cycle	Read access	~	×				-
Communication load	HM access	~					
System and clock memory	No access (complete protection)						~
SIMATIC Memory Card	<	11				>	
System diagnostics							
PLC alarms	Full access incl. fail-safe (no protection):						
PLC alarms	Full access incl. fail-safe (no protection): TIA Portal users and HMI applications will have acce No password is required.	ss to all sta	ndard and f	ail-safe fun	ctions.		
PLC alarms	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and f	ail-safe fun	ctions.		
PLC alarms • Web server	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and t	ail-safe fun	ctions.		
PLC alarms > Web server DNS configuration	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and t	iail-safe fun	ctions.		
PLC alarms > Web server DNS configuration > Display	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and t	ail-safe fun	ctions.		
PLC alarms > Web server DNS configuration > Display Multilingual support	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and f	lail-safe fun	ctions.		
PLC alarms > Web server DNS configuration > Display Multilingual support Time of day	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and t	ail-safe fun	ctions.		
PLC alarms	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and t	ail-safe fun	ctions.		
PLC alarms > Web server DNS configuration > Display Multilingual support Time of day > Protection & Security > OPC UA	TIA Portal users and HMI applications will have acce	ss to all sta	ndard and t	lail-safe fun	ctions.		
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FIG. 1. Enabling GET/PUT connection mechanism on PLC controller; the default is disabled.

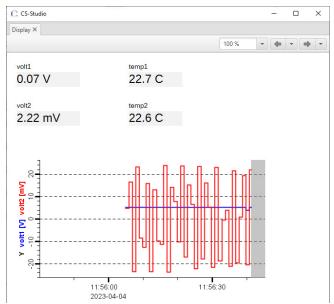


FIG. 2. Test CSS Phoebus screen showing PVs associated with PLC tags.