



SW for main protection functionality and management - IOCs

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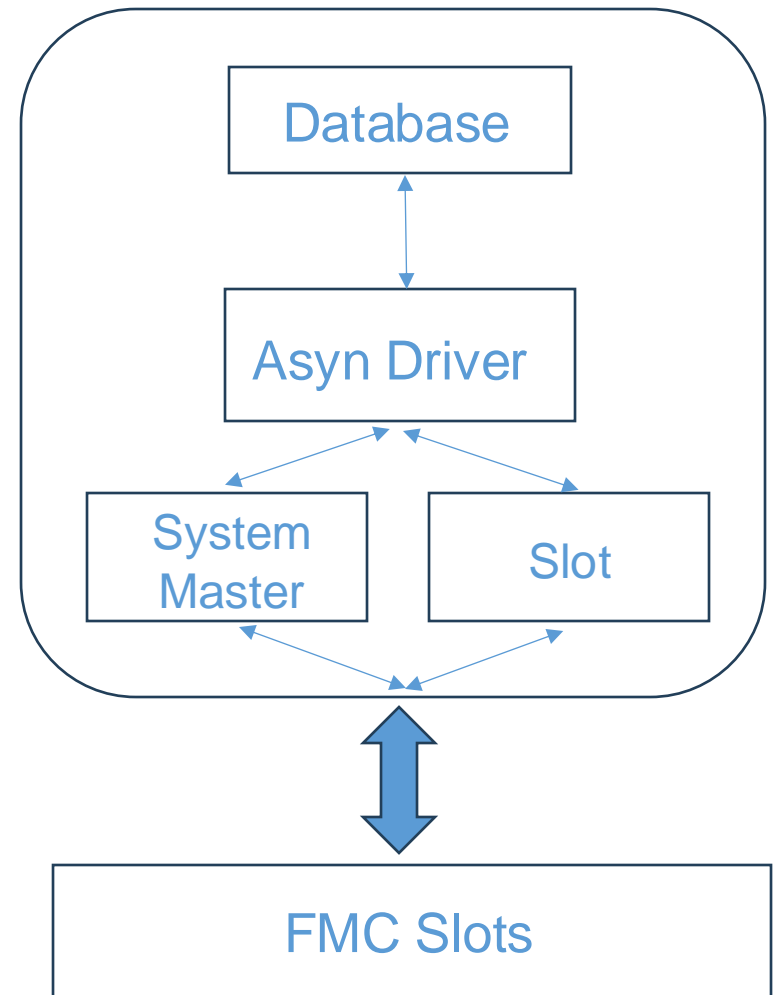
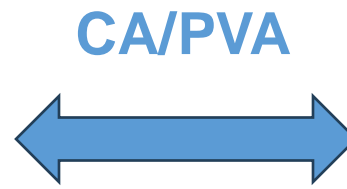
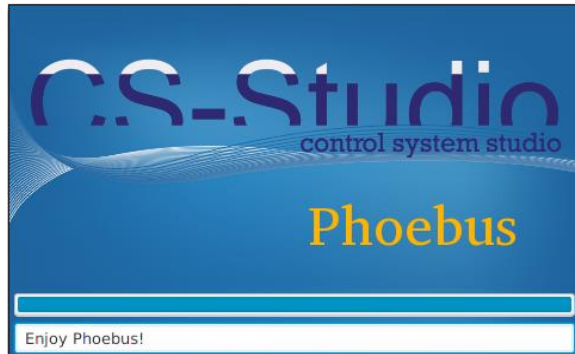
Requirements

- Software Layer must provide interface to fully control system parameters and provide monitoring and archiving of all critical data
- Execution of protection function must be independent of non-critical software components
 - No parts of protection function are running on SW level
 - Software can be started and stopped without disturbance to system functions
- In case of critical software fault, appropriate statuses must be reported and inhibit signals raised





The management IOC architecture





The management IOC architecture

- IOC contains *Asyn* driver that uses *systemMaster* and *Slot* to communicate with FMC slots and boards
- "Per slot approach" - PV database templates per slot
- Periodical data readout at regular, defined time intervals
- Multithread monitoring with callback approach
- No logic inside IOC, it only calls functions





The management IOC OPIs – main window

Main window of the management IOC:

- Overview of each FMS slot – statuses and feedback from monitoring.
- Each FMC slot can be reviewed in the export window (Expert button)
- Button to power cycle the whole system (with feedback information about the procedure success/failure)

The screenshot displays the 'RFPI Management' interface. At the top, there is a 'Power Supply Management' section with a 'Status' indicator (green circle), an 'OK' button, and 'Power' controls for 'ON' and 'OFF'. Below this, the interface is organized into a grid of eight slot status panels, labeled 'SLOT INTER', 'SLOT TOP0', 'SLOT TOP1', 'SLOT TOP2', 'SLOT MAIN', 'SLOT BOT0', 'SLOT BOT1', and 'SLOT BOT2'. Each panel contains 'Alarms' (INA Alarm and Power Alarm) and 'Status' (Occupied, Type, Status, Health) indicators, along with an 'ACK' button and an 'Expert' button. The 'Name' field for each slot is also visible. At the bottom right, there are buttons for 'ACK ALL', 'Other', and 'CS Circuits'.

Slot	INA Alarm	Power Alarm	Occupied	Type	Status	Health	Name
SLOT INTER	Green	Green	Green	Red	Red	Red	
SLOT TOP0	Red	Red	Green	Green	Green	Red	cs0
SLOT TOP1	Red	Green	Green	Green	Green	Red	ssa
SLOT TOP2	Red	Red	Green	Green	Red	Red	
SLOT MAIN	Green	Green	Red	Red	Red	Red	
SLOT BOT0	Red	Green	Green	Green	Green	Red	cs1
SLOT BOT1	Green	Green	Red	Red	Red	Red	
SLOT BOT2	Red	Red	Green	Green	Red	Red	





The management IOC OPIs – expert window

RFPI Management *Expert*

Errors

- Missing Board: ●
- Wrong Board Type: ●
- No Power: ●
- Power Not Ack: ●
- Overcurrent: ●

Status

Status: ● Occupied: ● Health: ●

Board

Type: ● Current:

Readouts

	Voltage	Current
OK:	●	●
Ch1:	<input type="text" value="11.94 V"/>	<input type="text" value="0.68 A"/>
Ch2:	<input type="text" value="3.39 V"/>	<input type="text" value="0.02 A"/>
Ch3:	<input type="text" value="1.78 V"/>	<input type="text" value="0.12 A"/>

Temperature:

Limits

	Warning	Critical
Ch1:	<input type="text" value="0.00 A"/>	<input type="text" value="0.00 A"/>
Ch2:	<input type="text" value="0.00 A"/>	<input type="text" value="0.00 A"/>
Ch3:	<input type="text" value="0.00 A"/>	<input type="text" value="0.00 A"/>

Voltage

	Low	High
Level:	<input type="text" value="0.00 V"/>	<input type="text" value="1.50 V"/>

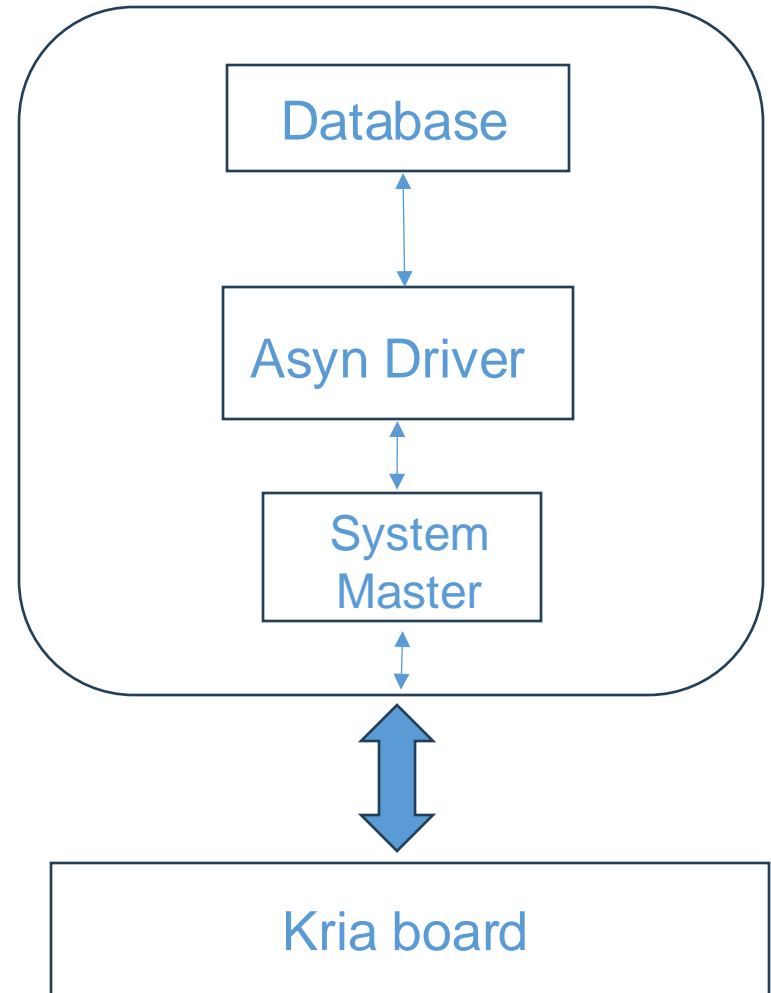
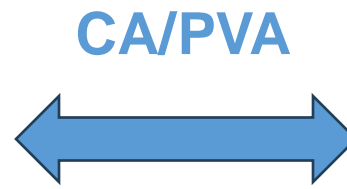
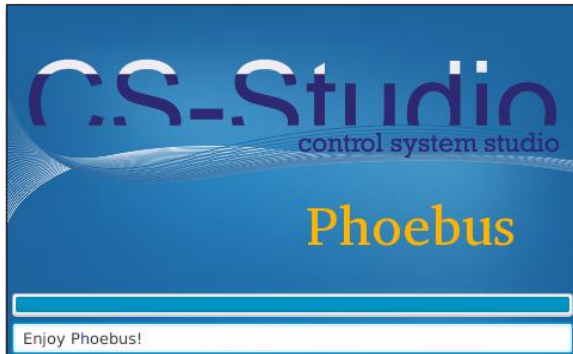
Expert window of the management IOC:

- Detailed information about slot status (occupied, powered, overcurrent etc.)
- Voltage, current and temperature readouts
- User can define voltage and current levels that will trigger alarms when exceeded





The main logic IOC architecture





The main logic IOC architecture

- IOC contains asyn driver that uses *systemMaster* class that provides all needed functionalities.
- Periodical data readout at regular, defined time intervals.
- No logic inside IOC, it only calls functions.
- The only algorithm inside IOC is used to sort events by timestamps in case of system failure.



The main logic IOC OPIs – main window

RFPI Kria Status

Alarms ACK

Diagnostics and Management Diagnostics/Management Settings

Inputs

Binary (PLC Based)

Cavity 1		Cavity 2	
Personnel Safety Permit C1	Personnel Safety Permit C2	Personnel Safety Permit C1	Personnel Safety Permit C2
Coupler Airflow sens C1	Coupler Airflow sens C2	Coupler Airflow sens C1	Coupler Airflow sens C2
SSA Ready C1	SSA Ready C2	SSA Ready C1	SSA Ready C2
Coupler Vacuum Permit C1	Coupler Vacuum Permit C2	Coupler Vacuum Permit C1	Coupler Vacuum Permit C2

RF Antennas

- RF Antenna 1 (NIRP1)
- RF Antenna 2 (NIRP2)
- RF Antenna 3 (NIRP3)
- RF Antenna 4 (NIRP4)
- RF Antenna 5 (NIRP5)
- RF Antenna 6 (NIRP6)

Permits

Cavity 1		Cavity 2		Cavity 3		Cavity 4	
LLRF Permit C1	LLRF Permit C2	LLRF Permit C3	LLRF Permit C4	LLRF Permit C1	LLRF Permit C2	LLRF Permit C3	LLRF Permit C4
SSA Permit C1	SSA Permit C2	SSA Permit C3	SSA Permit C4	SSA Permit C1	SSA Permit C2	SSA Permit C3	SSA Permit C4
SSA DC Permit C1	SSA DC Permit C2	SSA DC Permit C3	SSA DC Permit C4	SSA DC Permit C1	SSA DC Permit C2	SSA DC Permit C3	SSA DC Permit C4
MPS Permit C1	MPS Permit C2	MPS Permit C3	MPS Permit C4	MPS Permit C1	MPS Permit C2	MPS Permit C3	MPS Permit C4

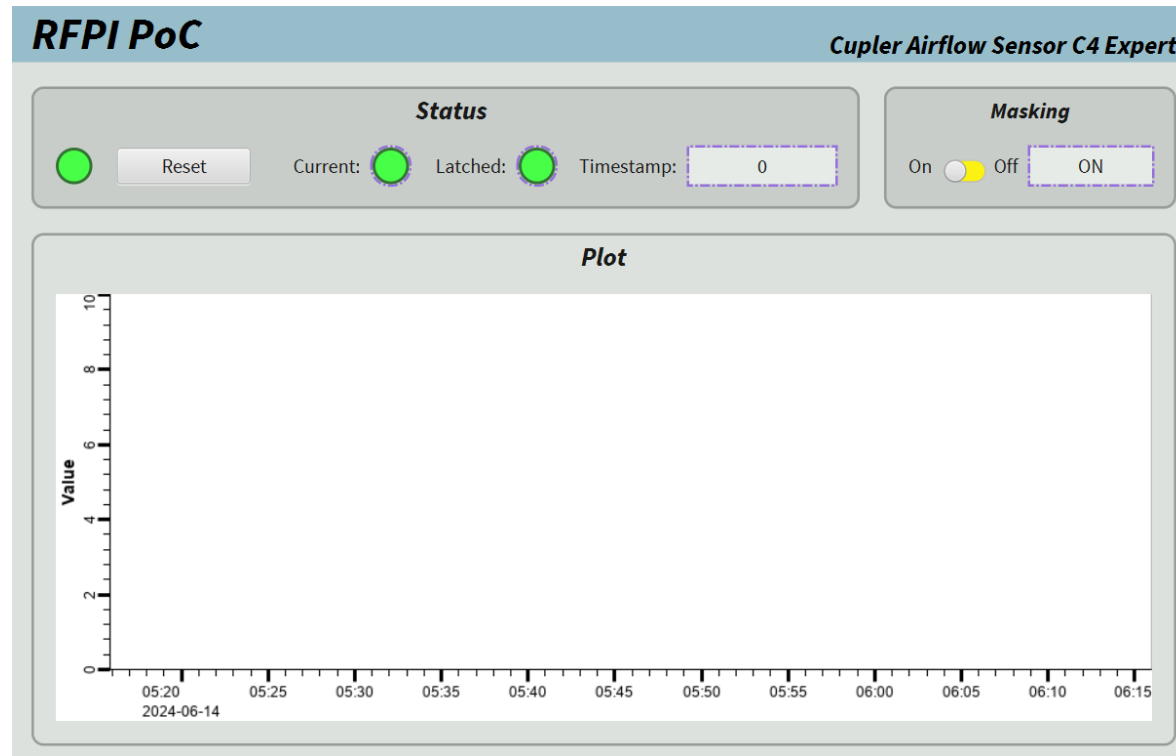
Reset

- Statuses of all input and output signals
- Communication alarm status
- Buttons to open "expert" windows for all type of signals





The main logic IOC OPIs – binary input window



- LEDs with final status, current status and latched status with timestamp
- Masking mechanism

• Signal plot





The main logic IOC OPIs – analog input window

- Provides final, current and latched status LEDs
- Raw and scaled values from the conditioning boards
- Masking mechanism
- Configurable threshold limits
- Counter readouts

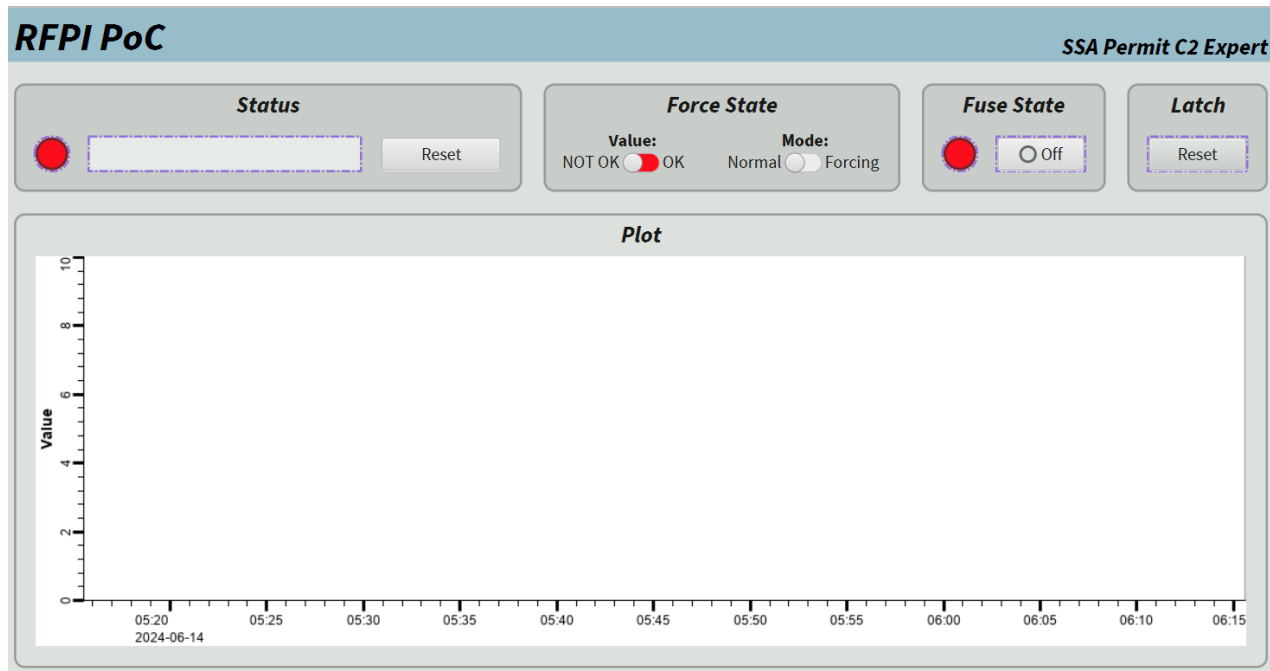
The screenshot displays a web-based interface for an analog input window. It is organized into several sections:

- Status:** Features three green LEDs labeled 'Current', 'Latched', and 'Timestamp'. A 'Reset' button is located to the left of the 'Current' LED. The 'Timestamp' field shows the value '0'.
- Values:** Displays 'Raw' and 'Scaled' values, both currently set to '0'.
- Configuration:** Contains two sub-sections:
 - Masking:** Includes a toggle switch currently in the 'ON' position.
 - Scaling:** Features input fields for 'Coeff' (1.00000) and 'Offset' (1.00000), with corresponding display fields showing '1.00000E0' and '1.00'. A 'Unit' field is empty and highlighted with a dashed border, and a 'Refresh' button is present.
- Thresholds:** A table with columns for 'Raw' and 'Scaled' values, and rows for 'Low' and 'High' thresholds. All values are currently '0'.
- Counters:** A table with columns for 'Counts' and 'Total Time', and rows for 'Low' and 'High' thresholds. All values are currently '0'. A 'Reset' button is located below this section.





The main logic IOC OPIs – permit window



- LEDs with final, current and latched statuses with timestamps
- Force state mechanism
- Signal plot
- Fuse status





The main logic IOC OPIs – postmortem analysis window

Post Mortem Analysis

Current	Latched	Mask	Timestamp	Sequence	Current	Latched	Mask	Timestamp	Sequence		
Field Emission Probe C1:	●	●	●	0	0	Personnel Safety Permit C1:	●	●	●	0	0
Field Emission Probe C2:	●	●	●	0	0	Personnel Safety Permit C2:	●	●	●	0	0
Field Emission Probe C3:	●	●	●	0	0	Personnel Safety Permit C3:	●	●	●	0	0
Field Emission Probe C4:	●	●	●	0	0	Personnel Safety Permit C4:	●	●	●	0	0
RF Antenna 1 (NIRP1):	●	●	●	0	0	Vacuum Status:	●	●	●	0	0
RF Antenna 2 (NIRP2):	●	●	●	0	0	Coupler Vacuum Permit C1:	●	●	●	0	0
RF Antenna 3 (NIRP3):	●	●	●	0	0	Coupler Vacuum Permit C2:	●	●	●	0	0
RF Antenna 4 (NIRP4):	●	●	●	0	0	Coupler Vacuum Permit C3:	●	●	●	0	0
RF Antenna 5 (NIRP5):	●	●	●	0	0	Coupler Vacuum Permit C4:	●	●	●	0	0
RF Antenna 6 (NIRP6):	●	●	●	0	0	He Level&Pressure (CRYO):	●	●	●	0	0
Temp Sensor RTD2 C1:	●	●	●	0	0	Coupler Airflow sens C1:	●	●	●	0	0
Temp Sensor RTD2 C2:	●	●	●	0	0	Coupler Airflow sens C2:	●	●	●	0	0
Temp Sensor RTD2 C3:	●	●	●	0	0	Coupler Airflow sens C3:	●	●	●	0	0
Temp Sensor RTD2 C4:	●	●	●	0	0	Coupler Airflow sens C4:	●	●	●	0	0
HV Coupler Bias Voltage C1:	●	●	●	0	0	SSA Ready C1:	●	●	●	0	0
HV Coupler Bias Voltage C2:	●	●	●	0	0	SSA Ready C2:	●	●	●	0	0
HV Coupler Bias Voltage C3:	●	●	●	0	0	SSA Ready C3:	●	●	●	0	0
HV Coupler Bias Voltage C4:	●	●	●	0	0	SSA Ready C4:	●	●	●	0	0
HV Coupler Bias Curr C1:	●	●	●	0	0						
HV Coupler Bias Curr C2:	●	●	●	0	0						
HV Coupler Bias Curr C3:	●	●	●	0	0						
HV Coupler Bias Curr C4:	●	●	●	0	0						

- Summary of all signal events together with timestamps when they have been triggered
- Sorted by timestamps to make postmortem analysis easier





Thank you!

