PAUL SCHERRER INSTITUT

SwissFEL Resonant Kicker Control System

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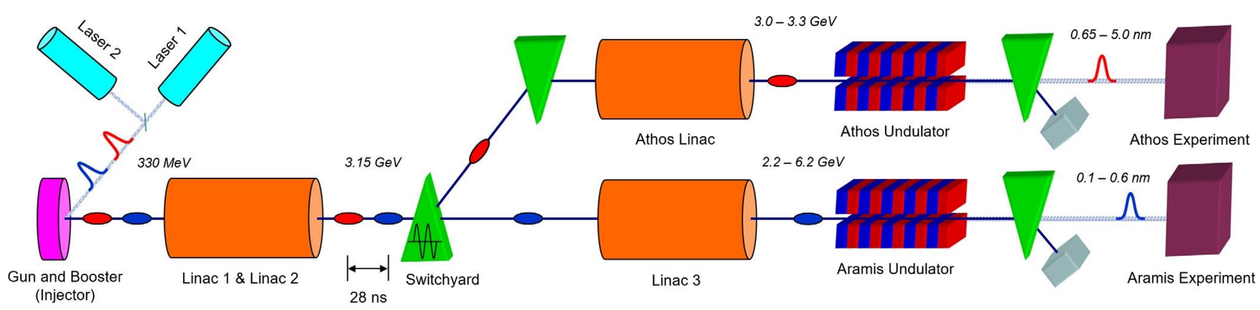
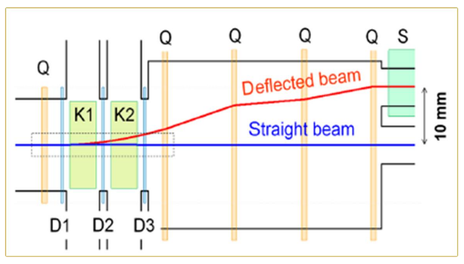
ABSTRACT

SwissFEL X-ray Free Electron Laser at the Paul Scherrer Institute is a user facility designed to run in two electron bunch mode in order to serve simultaneously two experimental beamline stations. Two closely spaced (28 ns) electron bunches are accelerated in one RF macro pulse up to 3 GeV. A high stability resonant kicker system and a Lambertson septum magnet are used to separate bunches and to send them to the respective beamlines. The resonant kickers control system consists of various hardware and software components whose tasks are the synchronization of the kickers with the electron beam, pulse-to-pulse amplitude and phase monitoring, generating pulsed RF power to excite a resonating deflection current, as well as movement of the mechanical tuning vanes of the resonant kickers. The feedback software monitors and controls all the important parameters. We present the integration solutions of these components into EPICS.

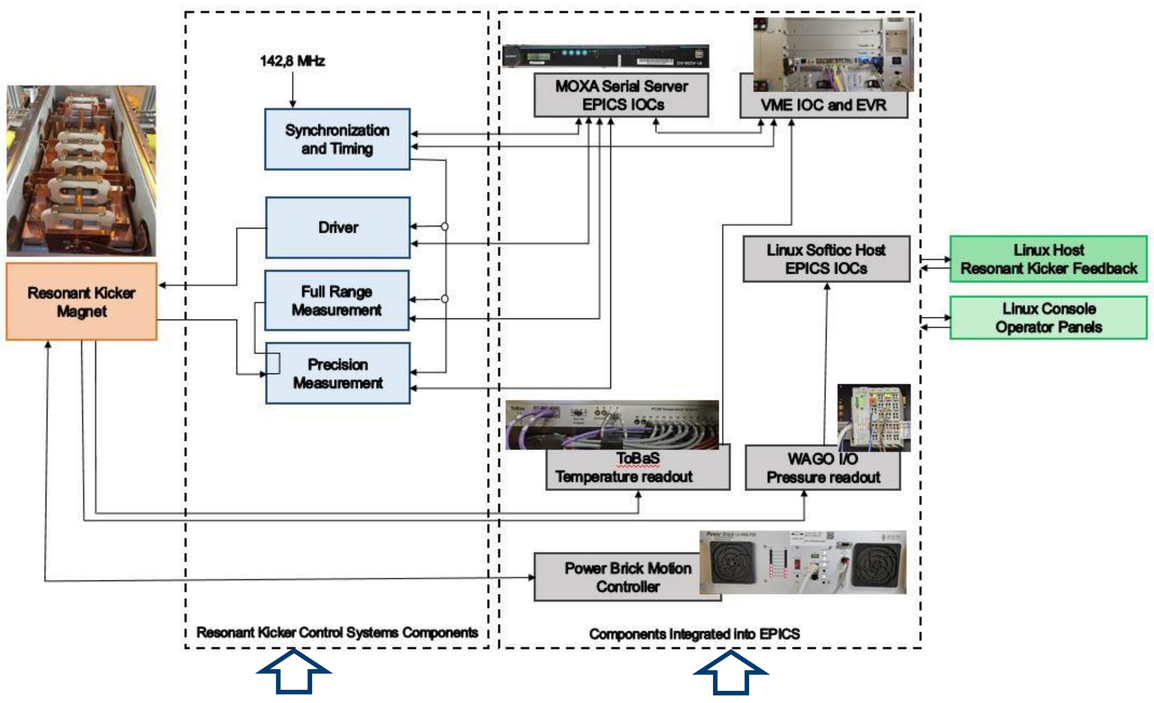
SwissFEL LAYOUT





Legend:
Q quadrupole magnets
K1, K2 resonant kickers
D1, D2, D3 compensating dipole magnets
S septum magnet

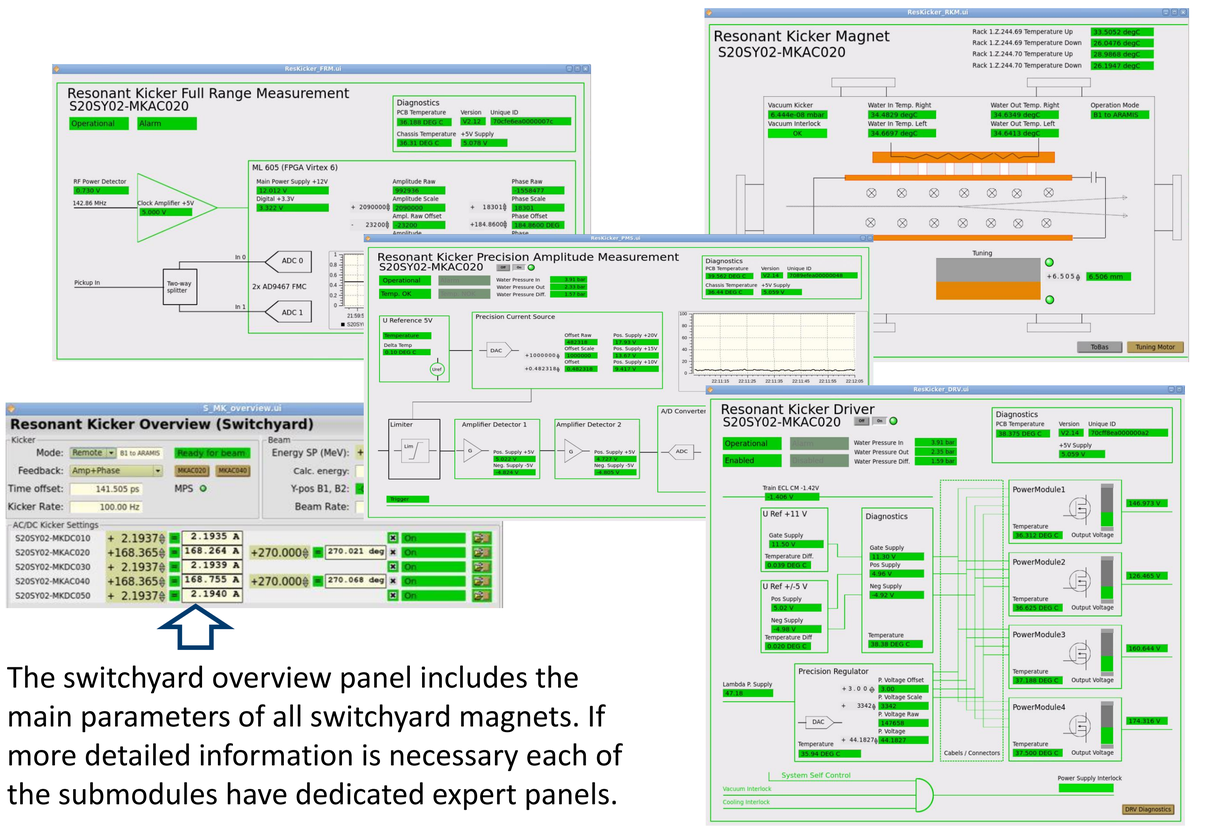
CONTROL SYSTEM OVERVIEW



The goal of Synchronisation and Timing system is to synchronize the kicker with the electron beam, Driver provides the kicker excitation power, Full range measurement provides pulse-to-pulse amplitude and phase information about the oscillating current, Precision measurement system provides higher resolution measurement of the kicker's current amplitude.

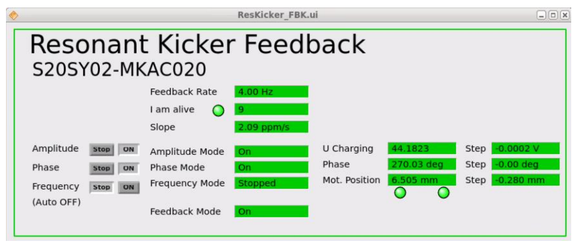
EPICS IOCs to control parameters of the kickers' electronic components are running on the MOXA Linux servers, connected via RS422, using stream device support. The motion control of the kickers' tuning vanes runs on the Power Brick Delta Tau Power PMAC system. For the temperature monitoring, a PSI in-house developed precise temperature measurement system is used. In order to detect cooling-water failures, pressure gages monitor the input and output of the cooling circuit pressure using the WAGO I/O system..

SWITCHYARD AND KICKERS USER INTERFACE



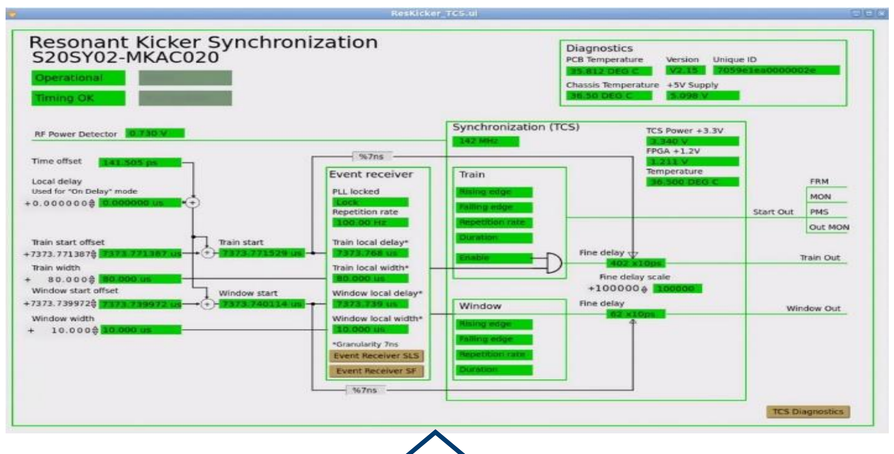
The switchyard overview panel includes the main parameters of all switchyard magnets. If more detailed information is necessary each of the submodules have dedicated expert panels.

FEEDBACK SOFTWARE



The goal of the feedback software is to control parameters by using EPICS PVs of the resonant kicker IOCs. There are three main feedback functions: amplitude control and phase control of the kicker's deflecting current and frequency tuning of the kicker.

TIMING PRECISSION DELAY



User interface to program the kicker's timing parameters: delay settings for the pulse train and measurement window. The phase control with smaller steps, as well as the local delay control is done dynamically in EPICS IOCs. Once a new delay value is programmed, the local EVR delay and the fine TCS delay settings are calculated in EPICS records and then they are programmed in the EVR and TCS systems. In this way the EVR timing granularity of ~7 ns is improved with the resolution of the TCS fine delay (10 ps).

CONCLUSION

The SwissFEL machine operates routinely in the double bunch mode which allows simultaneously operate two undulator beamlines Aramis and Athos. The separation of the two closely spaced (28 ns) electron bunches does not degrade the machine performance. The two resonant kicker magnet systems developed at PSI providing the separation between the two bunches run stable. Various electronic components are integrated into EPICS provide a comfortable interface for the SwissFEL Operation and hides the complexity of the systems.

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