PERMANENT MAGNET INSERTION DEVICE CONTROL SYSTEMS ON DIAMOND

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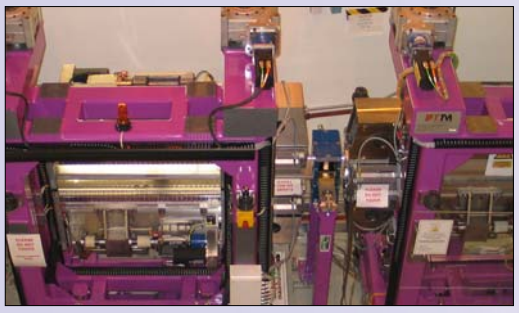

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REFERENCES

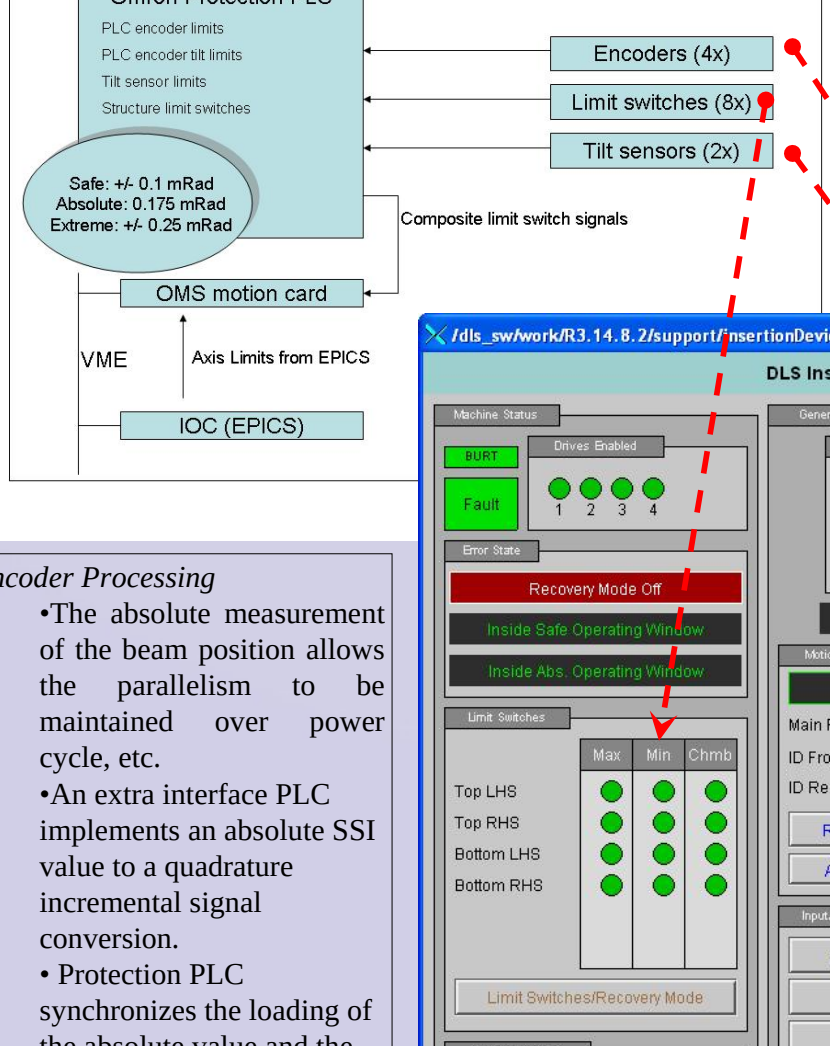
[1] A. Baldwin, et al. http://epaper.kek.jp/e06/PAPERS/THPLS128.PDF
[2] E. C. Longhi, et al. http://epaper.kek.jp/e08/papers/wepc119.pdf
[3] M. T. Heron, et al. http://epaper.kek.jp/e06/PAPERS/THPCH113.PDF

ABSTRACT

Diamond Light Source has designed and constructed twelve permanent magnet insertion devices over the past five years. These are ten In-vacuum undulators and two Ex-vacuum Apple II undulators. For all of these a common control system has been used. This uses a VME based motor controller, and a separate PLC subsystem for protection. The VME system runs EPICS to integrate in with overall control system. Two new designs of Insertion Device are currently in progress, which will require variants of this control system. The design for these control systems, issues experienced, and operational performance will be presented.

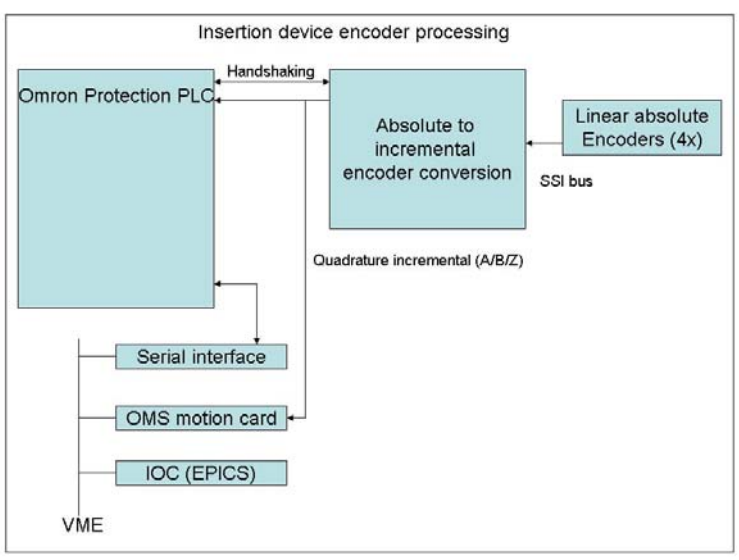
Protection system

- Protect the structure from failures in the motion control system.
- Operates independently of the motion control system.



Encoder Processing

- The absolute measurement of the beam position allows the parallelism to be maintained over power cycle, etc.
- An extra interface PLC implements an absolute SSI value to a quadrature incremental signal conversion.
- Protection PLC synchronizes the loading of the absolute value and the clocking of the quadrature signals to the protection PLC and the motion control card.

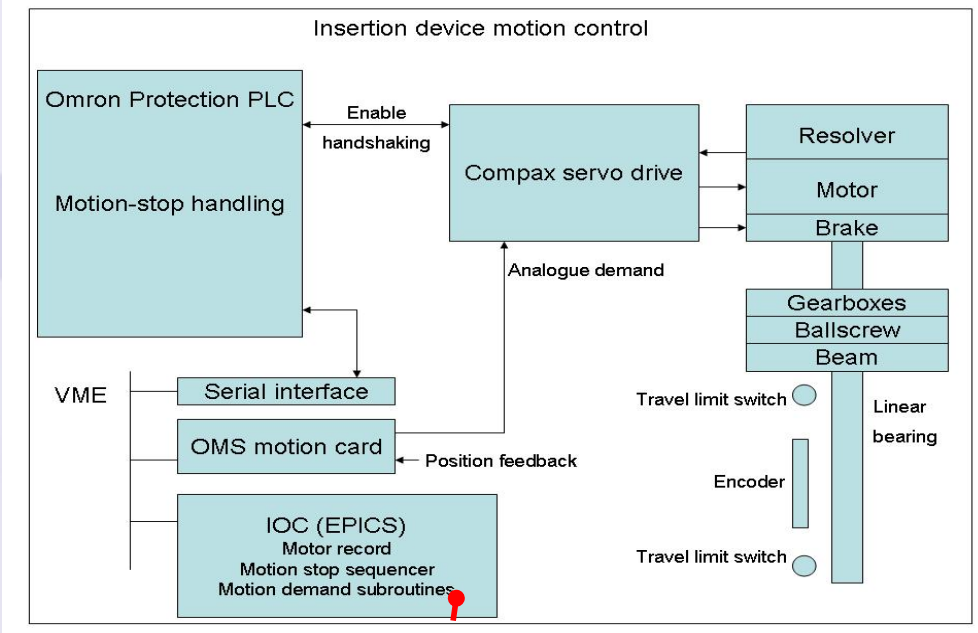


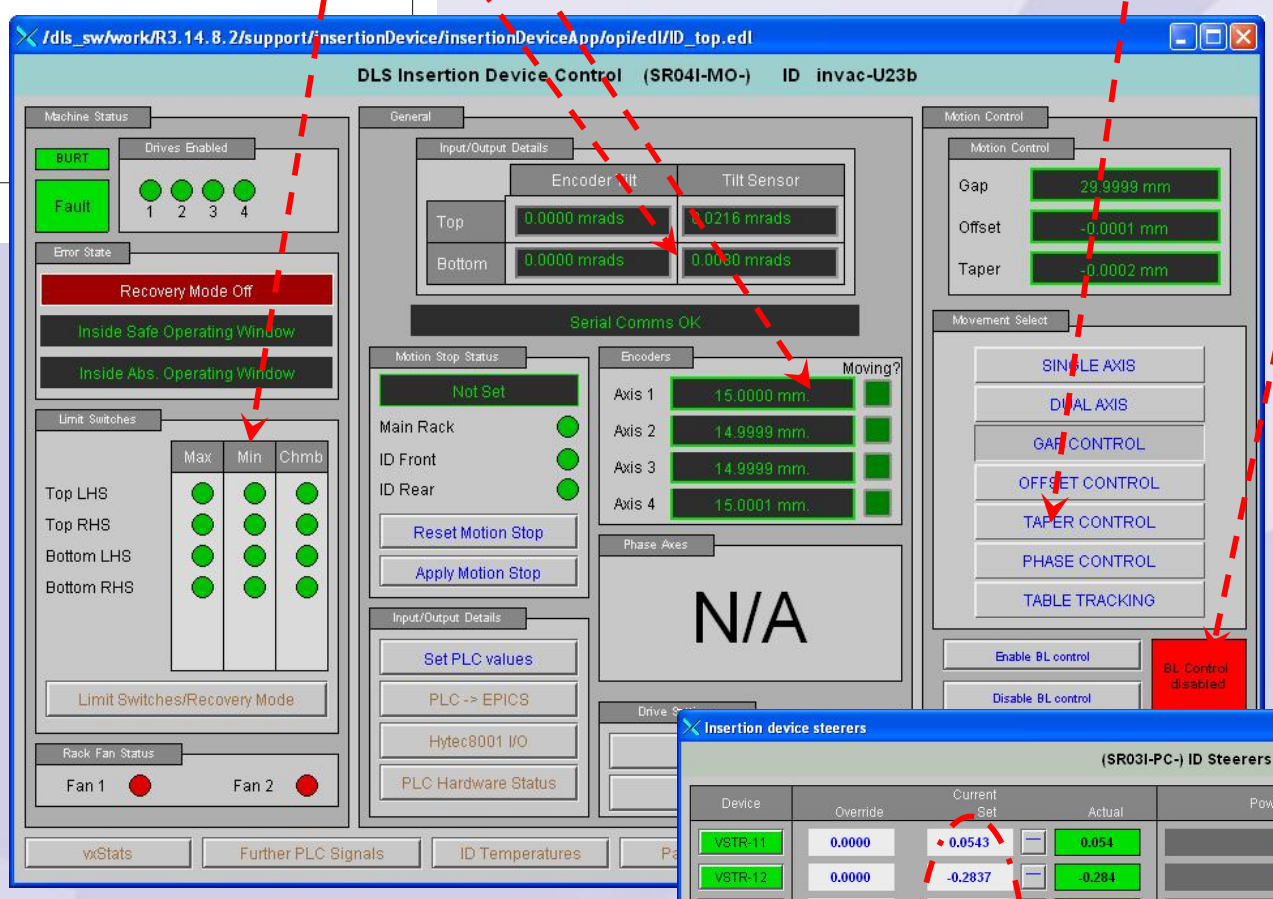
Velocity and position control

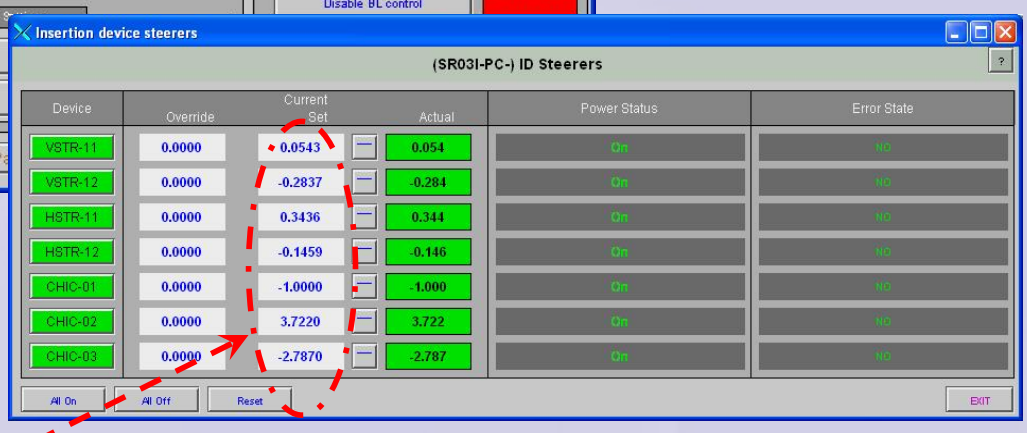
- Currently limited to a maximum 1mm/s gap based on the dynamic response of the tilt sensors is about 200ms.
- Reducing the per axis acceleration period from 2 seconds to 0.02 seconds, a control velocity of 2.6µm/s was achieved.
- Second requirement is 1µm step scans. By tuning the EPICS retry mechanism we found that this was achievable. The overriding requirement the step scans is that the scan sequence remains monotonic.

Motion Control

- The EPICS IOC provides the user interface mechanism and higher level controls.
- The MAXv card provides a 4 axis PID based control system with a 122 µs control loop time.
- Uses the EPICS motor support module.







Beamline communication

- Beamlines require automated scanning.
- Machine and beamlines isolated, except for an EPICS gateway
- Control of an insertion device from a beamline is implemented by 'pulling' the demand values across the gateway
- Also allows the machine side control system to implement an enable/disable control on the beamline based demands.

Trim coil control

- Two correction coils per end, for vertical and horizontal corrections. Each pair of coils is driven from a 5 Amp bipolar high accuracy DSP based power supply, controllable from EPICS.
- An EPICS genSub linear interpolation routine implemented to generate a current demand as a function of insertion device gap. The trim tables were obtained during the insertion device commissioning procedure [2].

EXPERIENCES

The reliability and performance of the insertion devices has been good [2].
Major issue has been the failure of the encoders during an electron beam dump. It appears that electron beam dump and the associated shower of particles can interfere with the embedded electronics of the absolute encoders. This was a significant issue during the early days of the storage ring commissioning. Better beam control and the correct setting of the collimators this problem has been alleviated to a large extent. Locating the encoders away from the plane of the electron beam is desirable.

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