TUP036

Application Software for the BSP-100 Beam Position Monitor at the APS

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Abstract

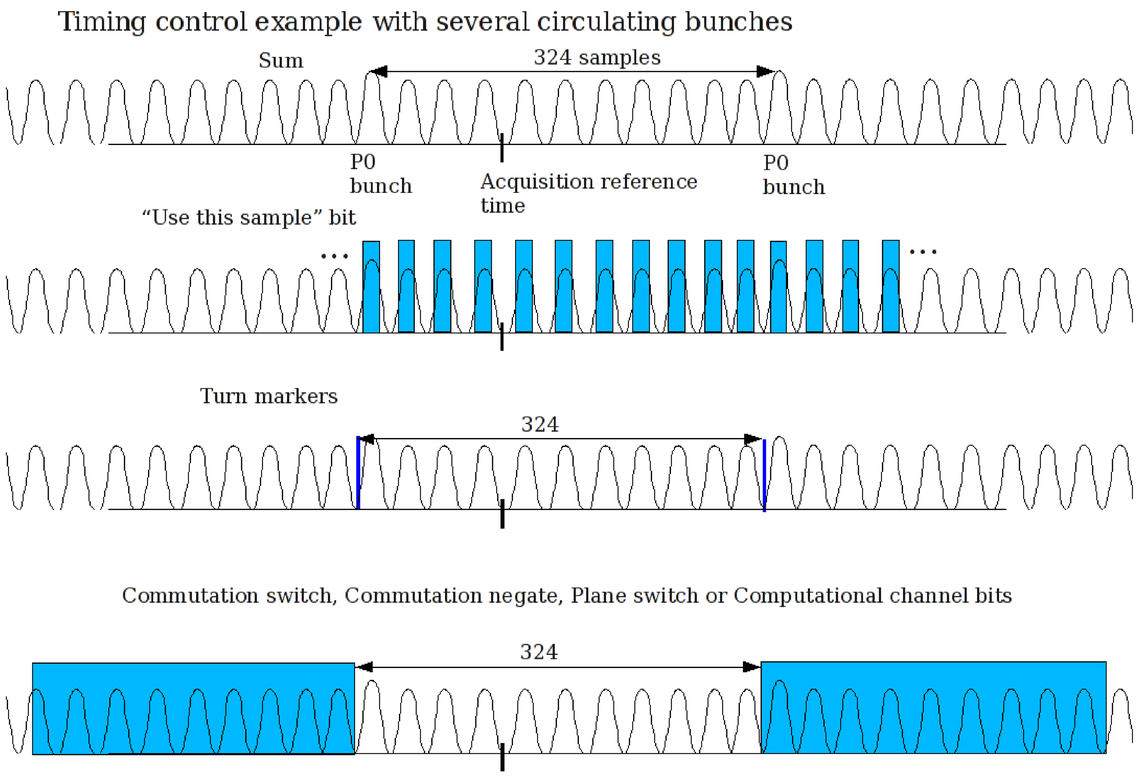
The BSP-100 beam position monitor (BPM) was commissioned and installed at the Advanced Photon Source (APS) in a fraction of the ring as an upgrade of the present turn-by-turn BPMs, the BSP-100 BPM adds a high-speed analog-to-digital converter and uses a field-programmable gate array (FPGA) to perform the signal processing. The main advantage of the new system is a much better signal-to-noise ratio as all the bunches in the stored beam can now be (selectively) sampled each turn. The implementation requires a much more complex timing control. We report on the high-level software that controls, saves, restores, and compares the timing of the BSP-100 BPM. This software uses Tcl/Tk for the graphic user interface, the SDDS toolkit for data processing, and SDDS-EPICS compliant tools for saving and restoring.

Features

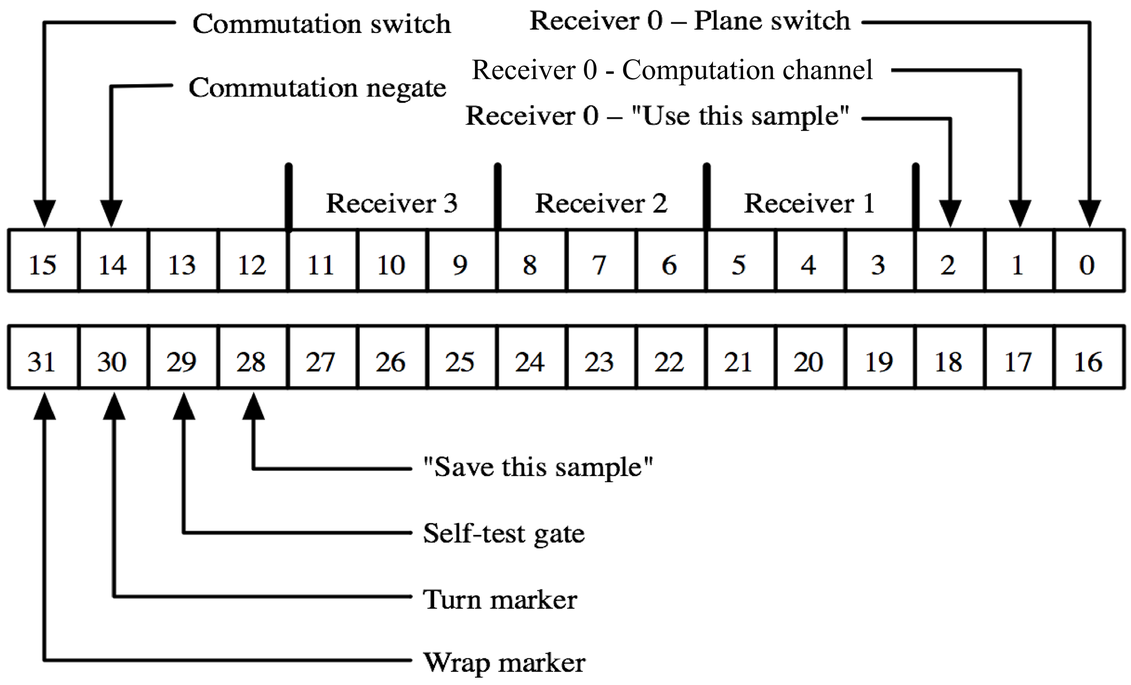
- Plane switching, phase switch commutation and data acquisition are now controllable on a sample-by-sample basis through 32-bit words
- We have a developed a system of GUI and tools to conveniently control the separate bits.
- One GUI controls 4 receivers, with each BPM having different plane switching, commutation, and data acquisition to achieve very level of flexibility. 38 waveforms (3888 elements for control and 4096 elements for data) are displayed in nested tab frames.
- The bunch pattern pre-sets facilitates setting up the desired acquisition control pattern for arbitrary bunch patterns.
- The generic SaveCompareRestore GUI (not shown) now allows EPICS waveform in all operations. Four reference configurations “Single Bunch”, “24 Singlets”, “324 Singlets”, “Hybrid” were set up for APS operation in controlling FPGA bpm timing.

Relevant SDDS tools and SDDS-compliant EPICS tools

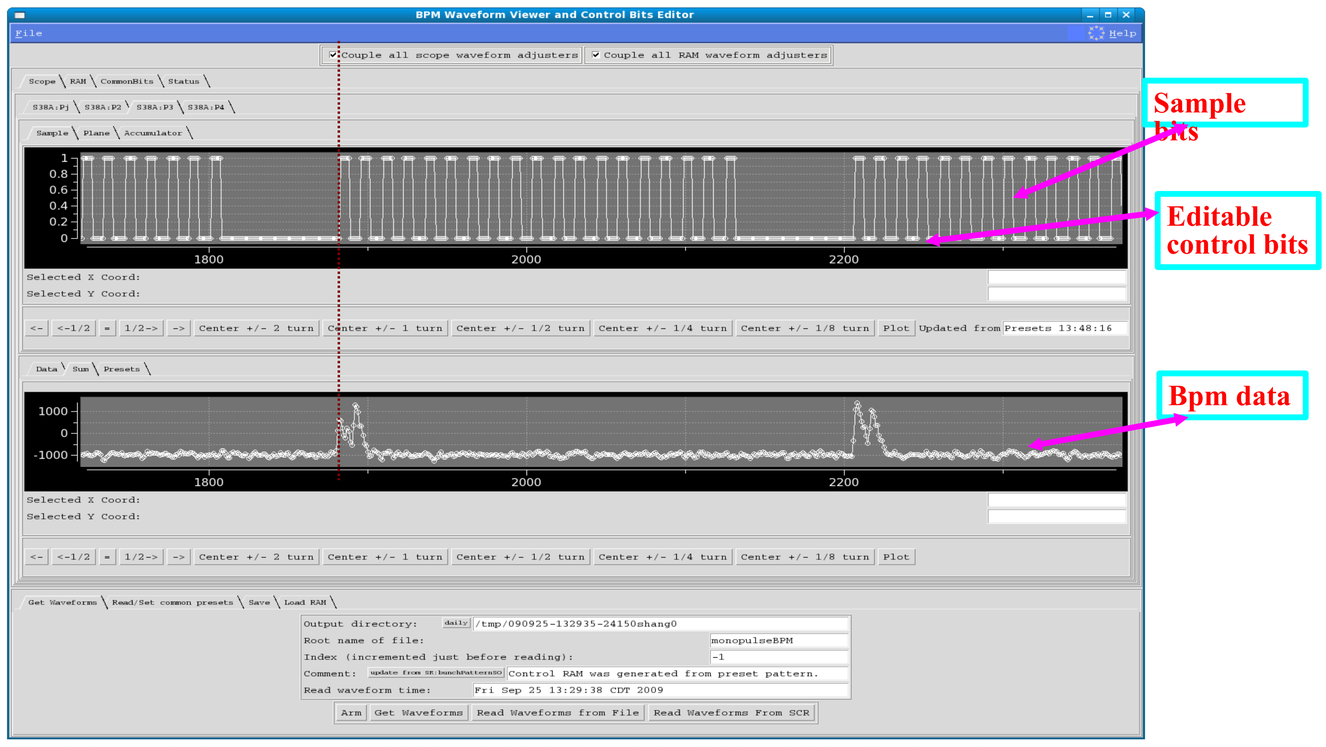
- sddsprocess – basic post-processing tool
- sddscar – save and restore configurations (used by SaveCompareRestore)
- sddsgencontrolbits – special-purpose EPICS tools heavily used
  - creates a file of BPM acquisition control bits from either EPICS record data (current configuration), a bunch pattern specification, or a RAM waveform file
  - Optionally set EPICS RAM record
- sddswget – read waveform record
- sddwput – set waveform record
- sddsbinarystring – convert integers into binary string values.



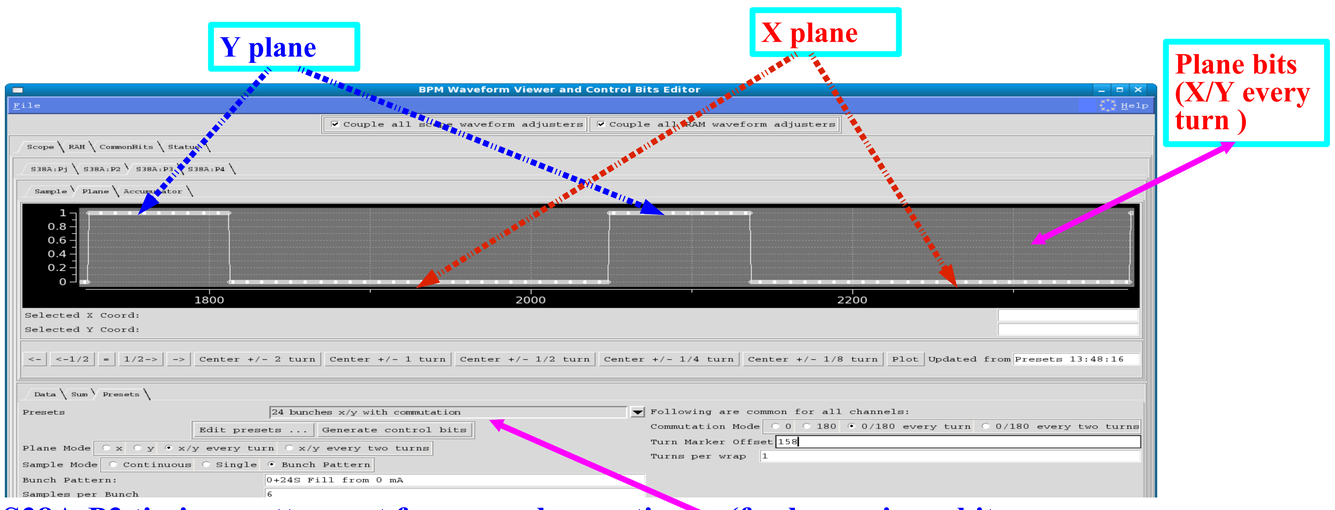
Sketch of BPM data and acquisition control-bit settings. “Use this sample” bits are set to match the timing pattern in the ring. Though a single bunch is 100 ps long, the electronic signal can span several 88-MHz sample clock periods.



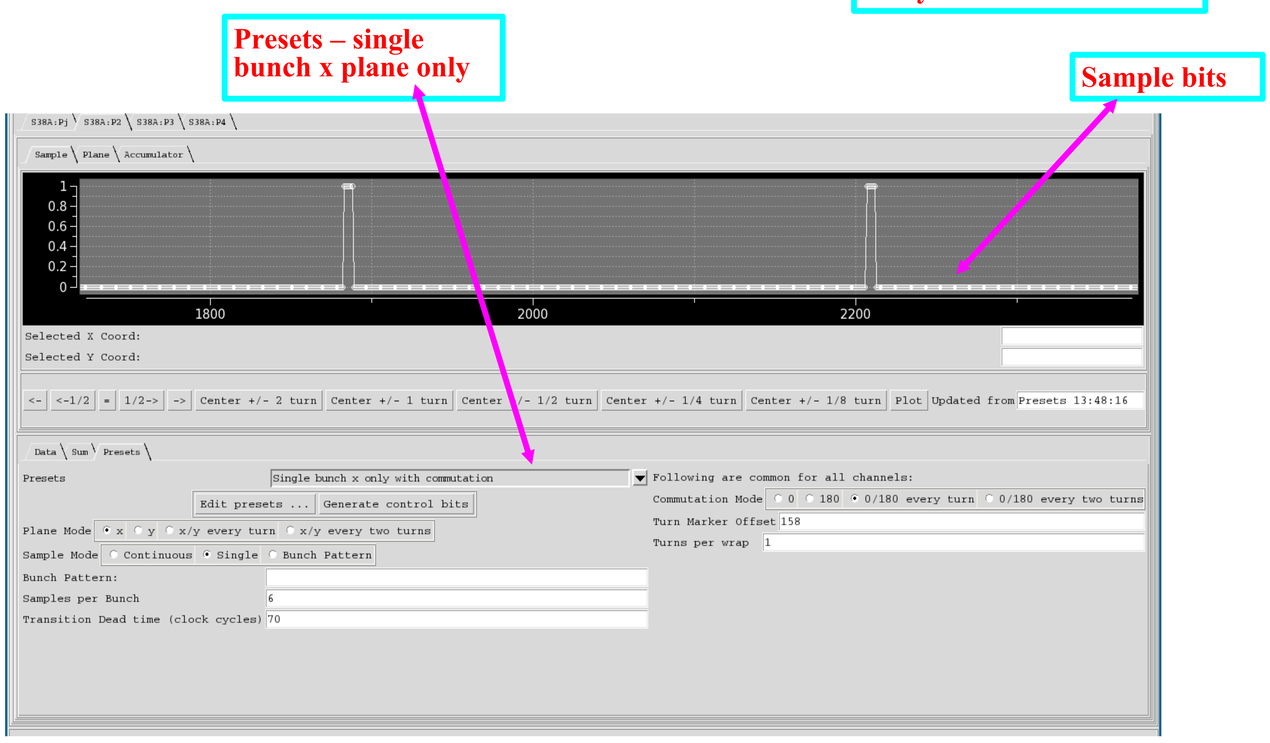
Acquisition control RAM bit assignments



RAM acquistion control of S38A BPMs in APS. (S38A:P3 is displayed, samples bits match the data points in a 24-bunch pattern)



S38A:P3 timing pattern set for normal operation (for low-noise orbit measurement in both planes)



S38A:P2 timing pattern for measuring injection transient in x plane to monitor the beam oscillation during top-up injections. (and S38A:P4 is used for y plane)