A.12: Transient Data Capture System for Indus-2 MPS Control Diagnostics

Indus-2 is a 2.5 GeV Synchrotron Radiation Source (SRS) operated as a booster as well as a storage ring for electron beam. The beam from booster is injected at 550 MeV which is then increased to 2.0/2.5 GeV. The process of increasing the beam energy is called ramping. The power supplies of various magnets are ramped synchronously for successful energy ramping. The control system for this machine is divided into various sub-systems with Magnet Power Supply Control System (MPSCS) as a major sub-system that is used to energize magnets during filling as well as during ramping. The part of MPSCS that mainly caters to ramping consists of 19 number of distributed VME stations controlling 29 power supplies distributed in the field.

The global data capturing rate of MPSCS is ~ 1 Hz which records control reference set-values, control reference values actually given to power supplies and actual read back values of power supplies. But during the ramping process, the control reference to the Magnet Power Supplies (MPS) is varied / ramped at rates between 20 Hz to 150 Hz. Thus a system polling data at 1 Hz may miss out any transient data variation occurring during ramping at this higher rate, which might destabilize the beam. For this purpose, a Transient Data Capture (TDC) system has been developed and incorporated in the MPSCS. This system helps in analyzing deviations in the actual control reference and the power supply read back signals from the intended values during the ramping process.

This system captures control reference and MPS read back signals simultaneously and synchronously for all the power supplies undergoing ramping. This is done using the ramp-clock itself that makes the process synchronized at distributed VME stations and helps in analyzing any deviation/transient disturbance. The amount of distributed data captured in one ramping cycle is typically of the order of 5 to 7 MB. This data is then collected and transferred to the user-interface level through the three layered architecture of the MPS control system. The main hardware used to achieve this functionality consists of VME based 24-bit ADC board and 18-bit DAC board for each supply, a common ramp-clock generator board, CPU boards and Profi communication boards.

Features

- The ADC card can capture 64,000 samples for a single channel or 32,000 samples for two channels with ramp clock rates up to 250 Hz at 16-bit accuracy into its on-bard RAM. This data is then transferred up to user interface level and presented in a CVS file for analysis.
- The user can select maximum two channels for data capturing from the - Read back, Reference read back, ADC reference and ADC analog ground.

Challenges

The overall system level challenges were:

- Keeping the present ramping scheme unmodified and undisturbed.
- Carrying out integrated, system qualifying tests after including the new scheme at the three layers of control system.
- Achieving the new functionalities with minimum additional hardware developments and by best utilization of the unused capabilities of the present system.

Following challenges were faced at hardware Level:

- Capturing of data from 2 channels in RAM
- Capturing of data at higher rates
- Qualification of data captured in RAM
- Providing diagnostics and test features.

Figure A.12.1 below shows the data of one of the several high accuracy power supplies captured at 100 Hz rate with the help of this system, while the power supply was being ramped. Tracking disturbances of the order of 100 ppm are seen being clearly highlighted in the graph.

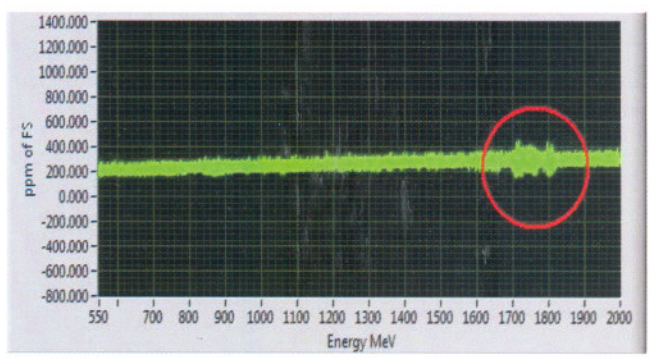

Fig. A.12.1: Tracking disturbance of Indus-2 Magnet Power Supply as captured by Transient Data Capture System

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