A.2: New control system for magnet power supplies of Booster Synchrotron

Booster synchrotron is an injector to the INDUS-1, and INDUS-2 SRS. Electron beam of 20 MeV energy from Microtron is injected in Booster synchrotron, which boosts the energy of electron beam to 450 MeV for filling beam in INDUS-1 and 550 MeV for filling in INDUS-2. There are six dipoles, twelve quadrupoles and five vertical steering magnets in the Booster synchrotron. Some of these magnets have main, secondary and even tertiary coils while the steering magnets have main coils. The magnet system is energized by 26 different power supplies, which are controlled and monitored remotely from the control room by magnet power supply control system. The control system is operational since 1992-93 and is quite old now and has almost completed its life. A new supervisory control system based on a different scheme is under fabrication at accelerator control section (ACS) for the replacement.

The new control system for the Magnet Power Supplies of Booster Ring is based on distributed control architecture. In this scheme each power supply will be controlled and monitored using a Digital Signal Processor (DSP) and Field Programmable Gate Arrays (FPGA) based embedded controller. The controller will be placed near the power supply. All the controllers pertaining to the power supplies of booster ring magnets will be communicating to a master server at user interface layer in control room on RS485 multi-drop serial link, using a custom protocol in command-response mode. The scheme of the booster magnet power supplies control system is shown in Fig. A.2.1 below.

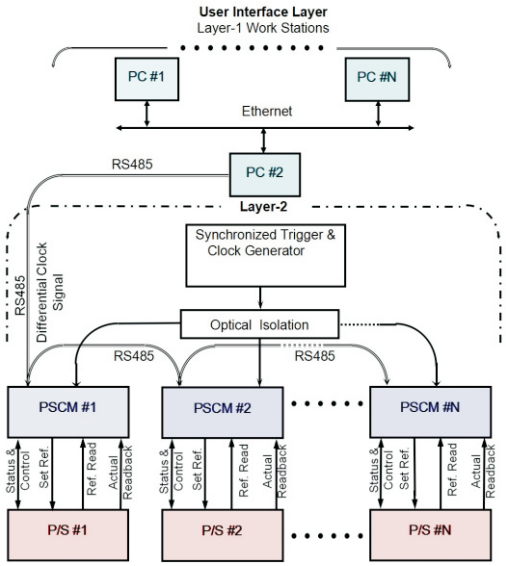

Fig A.2.1: Scheme of Booster magnet power supplies control system

Each of the controllers provide basic functions of monitoring of eight status parameters, digital controls of eight parameters, two analog inputs and two bipolar analog reference outputs with 16 bit resolution and stability of ±100 ppm. Fig. A.2.2 shows the DSP and FPGA based main circuit board of controller. For energy ramping of electron beam, magnetic fields of all the magnets are ramped synchronously. In the new scheme, reference of ramp profile will be generated synchronously by each of the controllers following a trigger input. Ramp profiles can be independently programmed in the controllers. Fig.A.2.3 shows typical ramp profiles of voltage reference and current reference for dipole power supply generated by this controller.

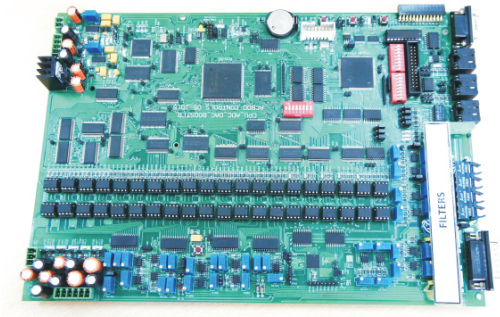

Fig. A.2.2: DSP and FPGA based main circuit board of the controller

Synchronous Ramp Data Capture

An important feature of the new booster power supplies control system is fast data capturing useful for reading ramp read back of the power supplies synchronous to external clock . This can provide useful comparison between the ramping current waveforms of dipole magnet and other magnets. A system of isolated external clock is also implemented to generate the synchronization clock.

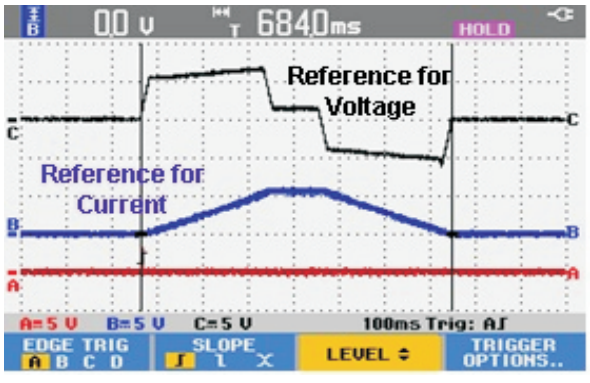

Fig.A.2.3: Ramp profiles of Voltage and Current references generated for dipole P/S

Reported by:
Seema Singhai Sheth (singhai@rrcat.gov.in), Yogendra Sheth and P. Fatnani