INTEGRATED SYSTEM ELECTRONICS AND INSTRUMENTATION ; OPERATION AND DIAGNOSTIC FOR ADITYA-U TOKAMAK

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SUMMARY:
The first phase operations of Aditya-U successfully performed various plasma experiments with repeatable plasma discharges of maximum plasma current of ~160 kA and discharge duration ~250 ms. The electronics and instrumentation requirement for these experiments are mainly of signal conditioning, embedded digital signal processing and automation. The signal conditioning electronics is developed to measure signal through sensors of different plasma diagnostics. The signal conditioning design incorporates amplification, attenuation, isolation, filtering, self-test and offset calibration. At present Electronic system caters around the need of hundreds of channels from different diagnostics of Aditya-U. These channels include electronics for Electromagnetic, Spectroscopy, Bolometer, Soft-x-ray, Microwave and ECE radiometer diagnostic to name a few.
For Aditya-U, Magnetic Probe Signal conditioning unit design is upgraded using CPLD, Electronics for the Soft-x-ray array detector is developed and most of the diagnostics electronics are integrated with in-house developed SBC DAQ system in same RACK. The integration of electronics with Data Acquisition system has improved the signal to noise ratio and eliminated long ground loops among channels which earlier needed additional electronics. At present four nos. of SBC based DAQ system each with 64 Analog Inputs are installed in Aditya. The DAQ system is triggered by in-house developed FPGA based Timing control system. The timing system provide trigger to different subsystems for synchronized operation in Aditya Tokamak.
For plasma operation of Aditya, Microcontroller and DSP based circuits are developed to control gas feed system in real time and to control radial position of plasma respectively.

For Aditya-U, PLC based Control system are installed for baking and conditioning of vacuum vessel. The vessel walls are heated at various temperatures in controlled manner for baking. Earlier baking was performed using auto transformer and individual PID controller making system large in size, distributed and disintegrated, requiring tedious wiring loops that involves manual setting. This PLC based system is rugged, reliable, small form factor and automated.

The paper will describe in detail electronics for plasma diagnostics, Instrumentation, embedded control and timing system for plasma operation.