Development of a VSWR Acquisition and Analysis Module on CompactRIO Using LabVIEW for the ICRH System

Abstract

Any mismatch in impedance results in reflected power, which is quantified using the Voltage Standing Wave Ratio (VSWR). Excessive VSWR can reduce power transfer efficiency and may damage sensitive RF components such as amplifiers, transmission lines and matching networks. Therefore, real-time acquisition, monitoring and analysis of VSWR are essential for the reliable and safe operation of the ICRH system. This work presents the development of a VSWR acquisition and analysis module using CompactRIO (cRIO) hardware and the LabVIEW platform for the ICRH system. The proposed module is designed to acquire forward and reflected RF power signals from directional couplers, process the acquired data in real time, calculate the VSWR continuously and provide visualization, logging, and alarm functionalities. The cRIO platform is selected due to its high-speed real-time processing capability, modular architecture, FPGA-based deterministic operation and suitability for industrial and scientific control applications.
The developed system integrates signal acquisition hardware, real-time data processing algorithms and a user-friendly graphical interface developed in LabVIEW. The module enables continuous monitoring of RF parameters, waveform visualization, fault indication, and storage of experimental data for further analysis. Real-time computation techniques are implemented to ensure fast response during abnormal operating conditions, thereby enhancing the protection mechanism of the ICRH system. The developed VSWR acquisition and analysis module improves operational reliability, enhances system diagnostics and provides a scalable architecture for future integration with ICRH DAC.

Academic Project Requirements:

1) Required No. of student(s) for academic project: 2

2) Name of course with branch/discipline: B.E./B.Tech. Computer Engineering/IT/MCA

3) Academic Project duration:

(a) Total academic project duration: 20 Weeks
(b) Student's presence at IPR for academic project work: 5 Full working Days per week

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