

L.5 : Supervisory control system for CUTE-FEL

Beam Physics and Free Electron Laser Laboratory (BPFEL) of the Materials, Advanced Accelerator Science, and Cryogenics Division of RRCAT, is developing a Compact Ultrafast Terahertz Free-Electron Laser (CUTE FEL). The machine, when in operation, will emit terahertz radiation. To avoid exposure to this radiation, the machine needs to be operated through remote control. For this purpose, a supervisory control system has been designed and developed by the Laser Electronic Support Section, RRCAT.

The CUTE-FEL consists of a thermionic gun, a beam transport line, a linear accelerator (LINAC) and an undulator assembly. The supervisory control system is designed to control the operations of all the subsystems of the FEL. It consists of a PC based master, and micro-controller based controllers, developed in house, which act as slaves. The overall system architecture is based on a distributed control scheme.

The control system uses two PCs located in the control room. The master PC provides a control console for FEL operation and other PC, referred to as the Supervisor, and interfaces various standard instruments to the supervisory control system on LabView platform. There are a number of slave controllers, which are placed all along various components of the FEL. These slave controllers, under supervision of master, provide necessary control signals to various magnet power supplies, RF system of FEL, and radiation monitor. Communication between master and slave controller is established with RS-485 network connected in a star topology.

The supervisory control systems perform the following tasks:

- It provides necessary analog and digital signals for operation of various magnet power supplies, and monitors their status.
- It monitors the status of the vacuum line of the FEL.
- It provides an interface to the RF system of the LINAC.
- It provides interface to all standard instruments which are used for diagnostics of FEL operation. The instruments include: RF power meter, RF signal generator, digital storage oscilloscope, radiation monitoring instrument, arc detectors in wave-guide etc.
- It provides an interface to the safety and interlock system of the machine.
- It provides a user friendly man machine graphic user interface for the user to operate the machine.

- It creates on-line plots of the parameters of user interest.
- It also allows the user to print the screen shots of various user screens.
- The control system creates a log of machine operation for future reference and diagnostics. It also creates a database of parameters, which were set by user during operation.

The Slave controller :

Each slave controller, in its standard configuration, is capable of providing 4-channel isolated analog input and outputs, and twelve isolated digital inputs and outputs. The design of these analog and digital I/O cards has been carried out using modular 3U, 220mm form factor. This scheme results in a highly configurable and scalable implementation of the slave controllers, with an ease of maintenance and upgradation.

Control Software :

The control software (See the screen shot in Fig.L.5.1) for the operation of the FEL machine runs on a Windows-XP based industrial PC. This software has been developed on LabVIEW platform. There are two distinct modules of the software. One module deals with the operation of the machine (running on Master Controller), where as the other module runs on Supervisor. The Supervisor does data logging and optimizes the operating conditions of the machine by observing its performance.

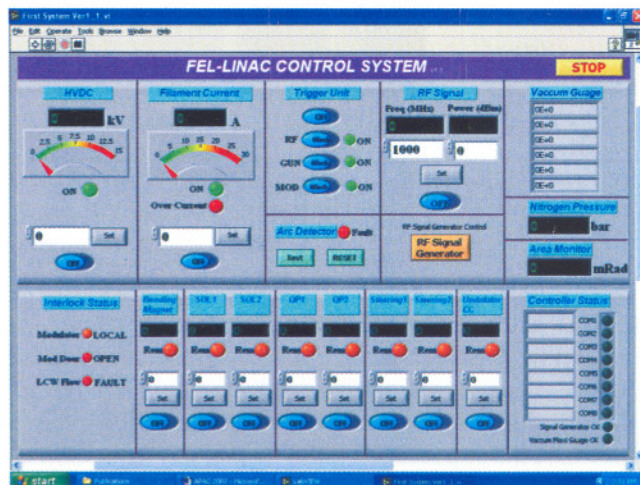


Fig.L.5.1: Screen shot of Man Machine Interface (MMI) for FEL system.

This control system is currently operational.

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