STATUS REPORT ON THE CONTROL & ACQUISITION SYSTEM OF LOW ENERGY ACCELERATOR FACILITY AT BARC

Sapna Padmakumar*, S K Singh, S V Ware, N B V Subrahmanyam, J P Bhatt, A Basu, S K Gupta and P Singh
LEHIPA, Physics Group, Bhabha Atomic Research Centre, Mumbai - 400085, India
sapna@barc.gov.in

Abstract

The Low Energy Accelerator Facility (LEAF) is a 50 keV, high intensity, negative ion accelerator facility that has been set up indigenously at VDG, BARC. This facility is capable of delivering a wide range of negative ion beams of both light and heavy ions across the periodic table. This facility is in use and various experiments have been done with negative ion beams.

A fast and reliable control system has been developed in-house for control of LEAF. This system is easily upgradable, scalable and simple to maintain. Control signals are communicated to high voltage areas through fiber optic cables. The control system has been in continuous use during experiments and its performance is satisfactory.

In this paper the salient features and details of the control system will be presented.

LEAF CONTROL SYSTEM

Low Energy Accelerator Facility (LEAF) is a DC electrostatic accelerator capable of accelerating negative ion beams up to 50 keV [1]. The control system of LEAF consists of PC as a soft console and NI make USB-6008 modules as the front end electronics. For control and monitoring the ion source devices, which are located in high voltage area, fiber optic communication is used. For all the accelerator devices located outside the ion source area the control and monitoring signals are through NI make USB-6008 modules with signal conditioning and protection.

The control system mainly aims at control & acquisition of field parameters in terms of voltage. National instrument's USB DAQ modules are used for providing the control voltages (DAC) to the field devices and sensing the field parameters (ADC). All the signal conditioning units and required hardware interfaces for these modules have been developed in-house.

Ion Source Control

In LEAF the SNICS ion source is kept at elevated potentials of -50 kV. Fiber optic data telemetry system provides the required electrical isolation in high voltage environments. Initially during commissioning, a micro-controller based control and monitoring system has been developed exclusively for the control of ion source parameters [2]. This compact modular design was developed with low cost devices that allow easy and fast maintainability. The whole control system was functioning stably and reliably for two years even in noisy environments such as RF & EMI conditions.

For achieving more flexibility in expansion of the control system, this µC based system has been upgraded to PC based system using NI USB-6008 DAQ modules. The functional block diagram is illustrated in figure 1. In this new system, the ion source control is accomplished through two computers, one being the main Control PC located on the control desk and the other located in the ion source high voltage area. Signals are communicated

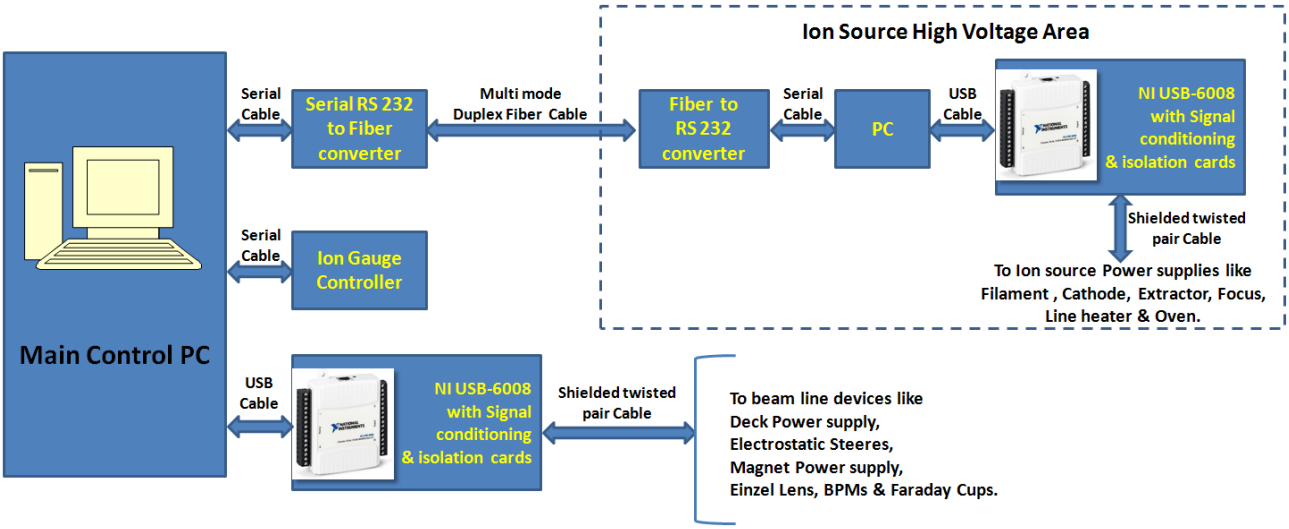

Figure 1: The block diagram of LEAF control architecture

through fiber - serial transceiver between the computers at the baud rate of 9600 bps. Commercially available multi mode fiber is used in the setup. The PC located in the high voltage ion source area runs a client control program, which receives control signals from the main control PC and control the ion source devices. The ion source PC houses a WLAN card and is controlled through main control PC via wireless LAN.

Beam line device control

For all the devices located outside the ion source area, National Instrument's USB DAQ modules are used for fast control and acquisition. USB-6008 module has ADC, DAC of 12bit resolution, digital I/O which very much suit our requirements. These devices are low cost, high reliable devices and give fast control and easy maintainability. The signal conditioning and isolation cards are developed in-house using opto-isolators & analog isolation amplifiers.

The Vacuum readings at various locations of the accelerator have been brought to the main control PC via serial port. Moxa's industrial serial multi-port device is used for interfacing various serial devices to main control PC. The beam current readings of faraday cups have also been displayed on the control pages by interfacing the faraday cups through USB DAQ cards.

SALIENT FEATURES

Fiber-optic systems use pulses of light traveling through an optical fiber to transmit data. This method offers complete input/output electrical isolation making it the first choice for communicating signals to high voltage areas. It neither radiates EM (electromagnetic) fields nor is it susceptible to any EM fields surrounding it.

Serial to fiber converter used in LEAF is a commercially available TCF -142 series MOXA module. The TCF-142 series converter is equipped with multiple interface circuit that can handle RS 232/422/485 serial interface and multimode or single mode fiber.

NI USB-6008 is a low cost, USB powered, 12-bit multifunction DAQ, which provides data acquisition functionality for our control application. These modules are compatible with LabWindows/CVI. The specification of the device is listed in NI website [3].

The software is developed in LabWindows/CVI. It is a powerful and easy to use tool for writing data acquisition programs, instrument control programs and very complete user interface. We have obtained run time license for LabWindows/CVI on LINUX. The software architecture implemented in the system is illustrated in figure 2.

The signal conditioning and isolation cards for protection of the control hardware from field disturbances have been developed in-house. It is achieved through opto-isolator 4N33, which is having input-output isolation voltage of 7.5 kVac. Similarly for the analog signal isolation AD210 isolation amplifier is used.

FUTURE PLAN & CONCLUSION

The control system is fully functional and various experiments have been carried out successfully. Future plans include setup of wireless communication link between the main control PC and ion source PC replacing the existing Serial-Fiber transceiver system. BPM digitizer using USB modules for viewing the beam profile on the control PC. Interfacing all turbo molecular pumps & vacuum gauges and fully automated operation of the machine. For integrating the FOTIA & LEAF control on single console, the transfer of LEAF control software to LINUX is under progress.

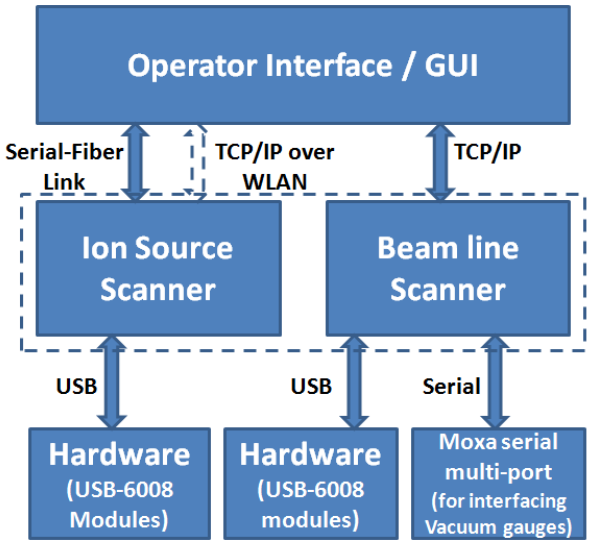

Figure 2: Software architecture of LEAF Control System

ACKNOWLEDGEMENT

We thank Dr. S Kailas, Director, Physics Group for supporting the activity. We thank S/Shri V. P. Singh, Pravin R. Parate, and Laxman D.Tayade, for their help during installation and testing.

REFERENCES

[1] Low Energy negative Ion Accelerator Facility at BARC.
N.B.V. Subrahmanyam, Arindam Basu, Arun Agarwal, S.K. Singh, Sapna Padmakumar, S. P. Sarode, S. V Ware, V. P. Singh, J. P. Bhatt, P. J. Raut, S. K. Gupta, P. Singh, R.K. Choudhury and S. Kailas., Proc. DAE-BRNS-PSI Symposium on Ion Beam Technology & Applications (SIBTA07), BARC, Mumbai, India, Sept. 19-21, 2007, Page 338.

[2] Micro controller based fiber-optic data telemetry system for the Ion source of LEAF at BARC. Sapna P, Shailaja V Ware, N B V Subrahmanyam, J.P. Bhatt, S.K. Singh, S.K. Gupta, P. Singh and R.K.Choudhury. InPAC-2009, RRCAT, Indore.

[3] The detailed specification is given at NI site http://sine.ni.com/nips/cds/view/p/lang/en/nid/201986.