Development of Remote Control and Interlock System for the PEFP Microwave Ion Source

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1. Introduction

The control system for a microwave ion source as an isolated high voltage device is a main part of the PEFP distributed control system [1]. The system is used to control two sets of microwave ion sources, the remote control and the interlock system. A VME system with an embedded PowerPC CPU is used as main computer. The VME system is dedicated to control and monitoring of the ion source operation. An isolated control system has been designed and developed for remote control and monitoring of a microwave generator and various power supplies. As the source is placed on high voltage platform, optical fiber isolation has been used between the serial to optical fiber VME I/O board and the control system on the high voltage platform. These are connected through RS232 serial interface. A fast Ethernet is used to communicate between the microwave ion source control system and other control stations in the PEFP control system. EPICS toolkit is adopted to provide network programming and user interface by using EPICS Channel Access (CA) [2, 3].

2. Hardware architecture

The schematic diagram of the microwave ion source control system is shown in Fig.1. It is a VME based control system. The VME control system is located in ion source gallery hall and connected to PEPF control network via a fast Ethernet network adapter. As the ion source is placed on high voltage platform, optical fiber isolation has been used between VME serial to optical fiber I/O board and optical to analog transition converter on the high voltage platform. These are connected through RS232 serial interface. All channels of the analog transition converter are connected with the microwave ion source components such as magnetron, power supplies, and directional coupler. Table I describes the control and monitoring signals for the ion source components.

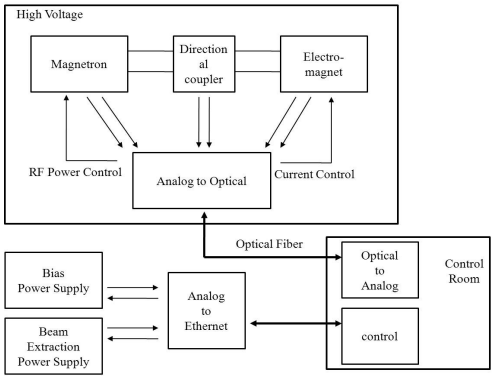

Fig. 1. Schematic of the ion source control

Table I: Remote control and monitoring

	Signal	type
Magnetron	Forward RF monitoring	0 ~ 10 V
	Reflected RF monitoring	0 ~ 10 V
	RF Power control	0 ~ 10 V
Magnet power supply	Voltage monitoring	0 ~ 10 V
	Current monitoring	0 ~ 10 V
	Current control	0 ~ 10 V
Directional coupler	Forward RF monitoring	0 ~ 10 V
	Reflected RF monitoring	0 ~ 10 V
Extraction power supply	Current monitoring	0 ~ 10 V
	Interlock	Relay
Bias power supply	Current monitoring	0 ~ 10 V
	Interlock	Relay

For the interlock system connections of the microwave ion source signals like analog I/O were set towards the analog to Ethernet converter for the safe management of the interlock conditions on the extraction and bias power supply.

2.1 VME based Control System

The VME PowerPC processor was adopted to accomplish compact hardware and flexibility of the I/O board handling and Input Output Controller server. Fig. 2 shows VME baseboard and VME serial to optical fiber I/O board.

Fig. 2. Serial to optical fiber VME I/O board

2.2 Optical fiber isolation

The serial to optical based analog transition converter is installed on the high voltage platform. The converter

consists of 16 ADC boards. Fig. 3 shows analog transition converter installed on high voltage platform. The features of the converter are as follows:

- analog input/output : 16 channels
- Insolated 232/485 communication: 2 ports
- Analog input range: ±5v, ±10, ±30 v selectable

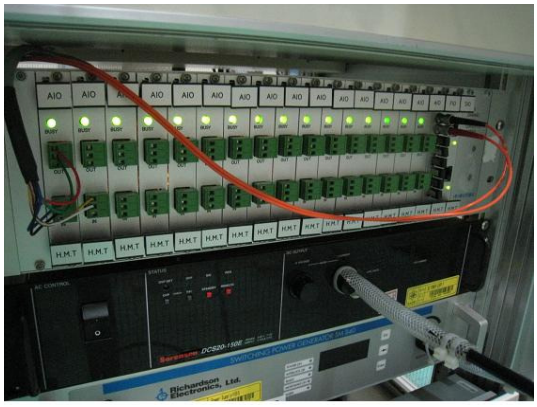

Fig. 3. Analog transition converter installed on high voltage platform

3. Software architecture

The EPICS is a kind of a toolkit that consists of a set of software components with which Application Developers can create a control system. The EPICS architecture is based on client/server model.

3.1 software design

The executable code generated from Solaris-based integrated development environment is loaded on the target board. The VME I/O driver and serial communication programming are written in operating layers of the EPICS software architecture. EPICS software flowchart for the IOC serial communication is presented in Fig. 4. The EPICS software consists of high level physics modeling making use of live data stored in the site relational database and dedicated equipment controllers, which in turn interface to specific equipment. The vxWorks startup script is used to load EPICS software and database. The path for the startup script is specified in the boot parameters.

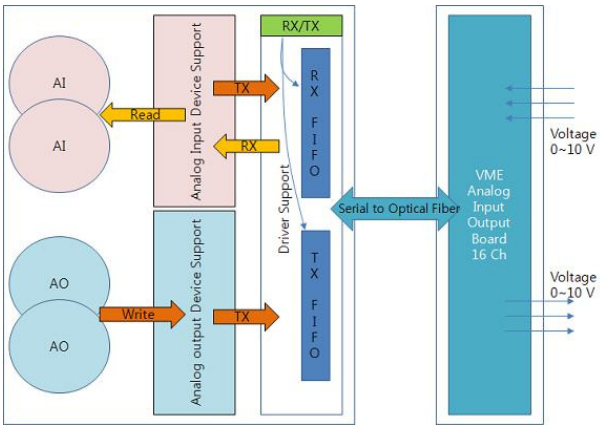

Fig. 4. Schematic of software architecture

3.2 Operator interface (OPI)

The EPICS extensions are chosen for Graphic User Interface (GUI) tools. Fig. 5 shows operator interface using EPICS Extensible Display Manager (EDM) [4]. It is possible to remotely control and monitor operation parameters from the microwave ion source control system.

Fig. 5. Operator Interface (OPI) for remote control

4. Summary

The control system for the microwave ion source is presently under test. The analog input/output board on high voltage platform will be changed to digital communication interface such as RS232 and RS485 to protect signal from noise. The microwave ion source control system will be tested and upgraded.

5. Acknowledgements

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Reference

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