THE RF CONTROL SYSTEM OF THE SSRF 150 MEV LINAC

S.M. Hu, J.G. Ding, G..Y. Jiang, L.R. Shen, M.H. Zhao, S.P. Zhong
SSRF, SINAP, Shanghai 800-204, P. R.China

Abstract

Shanghai Synchrotron Radiation Facility (SSRF) use a 150 MeV linear electron accelerator as injector, its RF system consists of many discrete devices. The control system is mainly composed of a VME controller and a device interface. The device interface is a home-made signal conditioner with DC power supplies. The DC power supplies are used for driving the mechanical phase shifters. This uniform signal conditioner serves as a hardware interface between the controller and the RF components. The control software is based on EPICS toolkit. Device drivers and related runtime database for the VME modules were developed. The operator interface was implemented by EDM.

INTRODUCTION

The injector of the Shanghai Synchrotron Radiation Facility (SSRF) is a 150 MeV linear electron accelerator [1], and it is shown in Figure 1. The RF system of the 150MeV Linac is composed of many individual components with different interfaces. The layout of RF system is shown in Fig. 2. A universal RF device interface was designed and manufactured to accomplish the RF system control mission. Connections between the local controller and RF devices are fully isolated by either the controller interface or the devices itself.

The RF controller consists of a VME system and a device interface. It controls many of the discrete RF components directly, that include 3 solid RF amplifiers, 12 klystron focus coil Power supplies, 3 phase shifters, and it also monitors vacuum of the klystrons and operates the reverse power protect resetting keys. Besides, there are several sub control systems:

- A sub-harmonic cavity is tuned by a stepping motor, which is controlled through a serial communication server.
- A Phase control sub-system [2] consist of a compact PCI cabinet and several modules.
- The controls for the 2 sets modulators [3] of RF power system by PLCs.

The Linac RF control system has been put into operation since July of 2007 and worked stably by now.

Figure 1: 150MeV Linac of SSRF.

SYSTEM CONFIGURATION

The Linac RF control system employs Ethernet-based distributed architecture. In the RF control system, we adopt the Experimental Physics and Industrial Control System (EPICS). The RF control system consists of

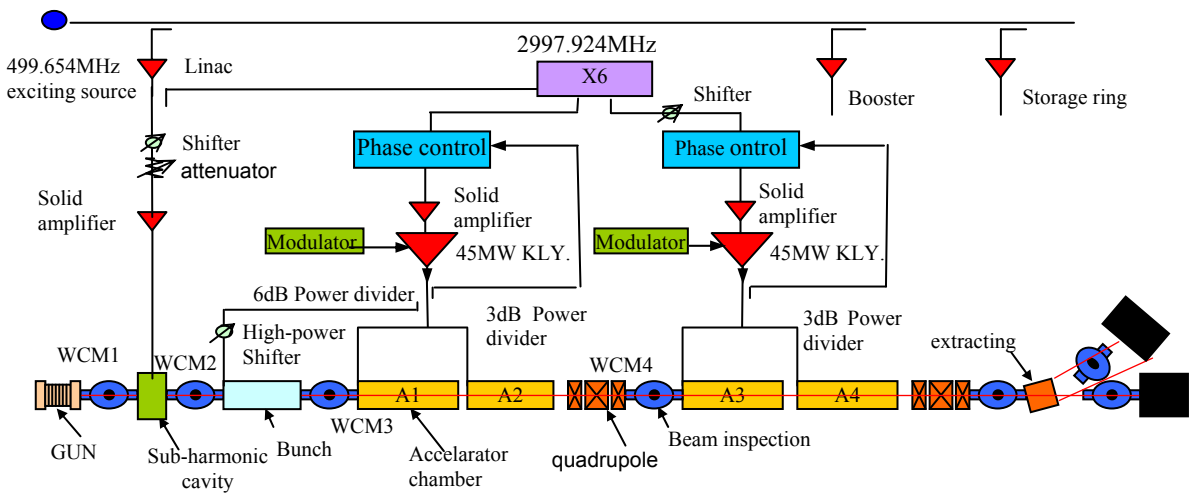

Figure 2: 150MeV Linac RF system layout.

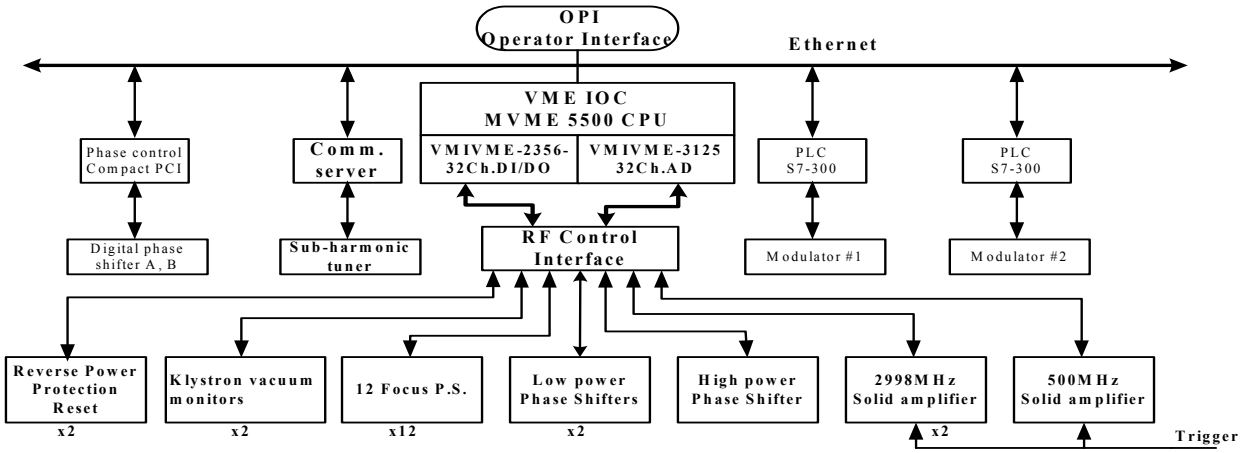

Figure 3: RF control system structure.

Operating Interfaces (OPI), Input/Output Controller (IOC). The Gigabit Ethernet switches link the OPI and IOCs to the SSRF control net. The SSRF timing system provides triggers to the amplifiers and modulators. The structure of RF control system is shown in Figure 3

Controller and Interface

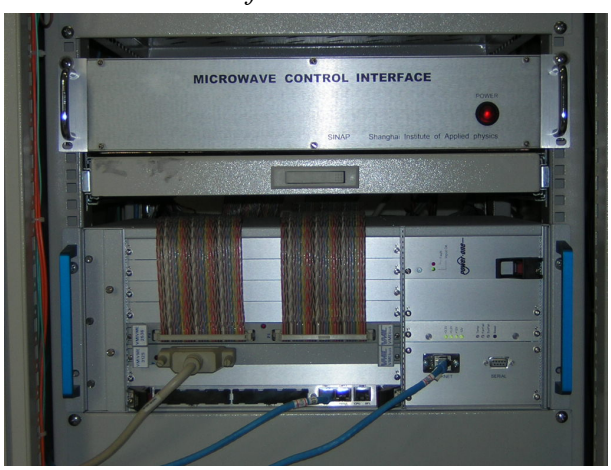

Figure 4: IOC controller and Interface.

The RF Controller and interface are shown in Figure 4. It consist of a 9-slot VME crate, a MVME 5500 CPU board, a VMIVME 2536 digital I/O isolated interface board and a VMIVME3125 A/D isolated interface board.

The dedicated interface of RF devices is designed and manufactured by SSRF for the linac RF control system. It is used not only for interface conditioning, but for power supply as well. The interface is designed for universal purpose, its most configurations are jumper selectable. The input/output interface between the controller and devices are optoelectronic isolated.

Software

EPICS toolkit was used for development of the RF control system. For different equipment interface and communication protocol, specific device support and driver is necessary to make the device to be controlled by EPICS [4]. The VME device support and drivers adopted in the RF control system were developed. The epics driver for VMIVME 2536 was written in 2002, for a 100MeV Linac control system; and epics driver for VMIVME 3125 was written in 2006. There are some drivers provided by the EPICS community, for example, S7-PLC [5] and NetDev [6] are used for Ethernet device control.

The operator interfaces of the RF control system were implemented by EDM.

CONCLUSION

The RF control system of SSRF 150MeV Linac has been operating for a period of more than 4 years, it has been testified that this control system is a low cost and more cost-effective solution to SSRF linac RF system. The control interface is a universal and convenient adapter to the controller and RF devices, and it works stably.

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