INSTALLATION AND OPERATION OF THE RF SYSTEM FOR THE 100MeV PROTON LINAC*

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Abstract

The RF system of the 100MeV proton linac for 1st phase of KOMAC (Korea Multi Accelerator Complex) has been installed at the Gyeong-ju site. The 100MeV consists of a 3MeV RFQ, a 20MeV DTL with four tanks, two MEBT tanks, and seven 100MeV DTL tanks. For the 100MeV linac, nine sets of LLRF control systems and the HPRF systems including 1MW klystrons, circulators and waveguide components have been installed at the klystron gallery, and four high voltage converter modulators to drive nine klystrons have been installed at the modulator room. A RF reference system distributing 300MHz LO signal to each RF control system has also been installed with a temperature control system at the klystron gallery. The requirement of RF field control is within +/- 1% in RF amplitude and +/- 1 degree in RF phase. The RF systems for the 20MeV linac have been operated, and RF conditioning for the 100MeV linac will be started shortly. The installation and operation of the RF system for the 100MeV proton linac are presented in this paper.

INTRODUCTION

The 100MeV proton linear accelerator has been developed and has been installed in Gyeong-ju site [1-4]. The 20MeV proton linac has been already operated at the Korea Atomic Energy Research Institute (KAERI) site, and has been moved to the new site and re-installed with the 100MeV Linac. For the 100MeV linac, the high power RF (HPRF) system including klystrons, circulators, high power dummy loads, and waveguide components has been installed. The low-level RF (LLRF) control system with a commercial Field Programmable Gate Array (FPGA) module and a LLRF analog chassis has been also developed and installed. A RF reference line has been installed with a temperature control at the klystron gallery. The RF conditioning starts and the RF system is operated with EPICS operator interface for the 100MeV linac.

RF INSTALLATION

The RF systems for the 100MeV linac have been installed, and the specifications of the RF system were summarized in Table 1.

HPRF System

The layout to install the HPRF systems for 100MeV linac is shown in Figure 1.

Table 1: Specifications of the RF System

Parameters	Specifications
Operating frequency	350MHz
RF power (peak)	1.6MW
RF Duty	9%
Pulse width / rep. rate	1.5ms / 60Hz
Transmission line	WR2300 waveguide
Stability of RF field	±1% in RF amplitude, ±1deg. in RF phase

Nine HPRF systems have been installed at the klystron gallery, which include klystrons, circulators, HPRF dummy loads, and waveguide components. One klystron drives one accelerating cavity basically, but in the case of RF system for the 20MeV DTL, One klystron drives 4 tanks, so RF power from a klystron is split by magic Ts and each waveguide runs in 4 ways. The waveguide penetration sections to transmit RF power to each cavity in the tunnel have the bending structure for radiation shielding. Figure 2 shows the RF systems installed at the klystron gallery.

The LLRF control system, a RF reference system, resonance cooling control systems, magnet power supply of drift tubes and beam line, and diagnostics and control system have been also installed at the klystron gallery.

Figure 2: RF systems installed at the klystron gallery.

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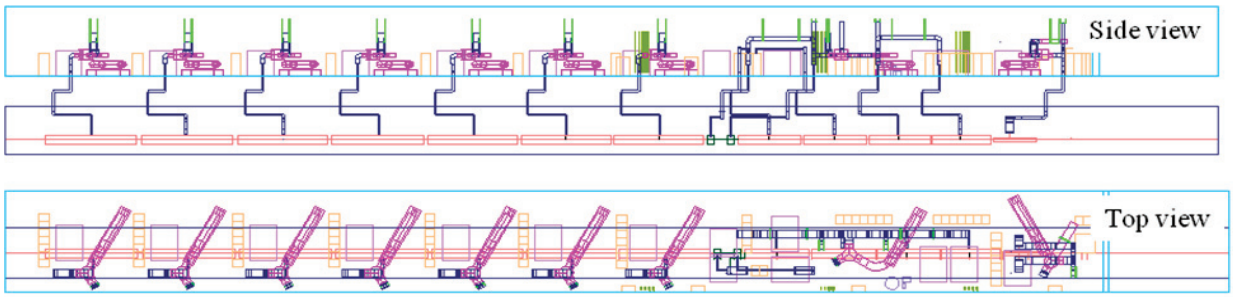

Figure 1: HPRF system layout for the 100MeV Linac.

LLRF Control System

The LLRF control system includes a commercial FPGA module, a LLRF analog chassis and a klystron drive amplifier. A commercial high-speed FPGA module (Pentek 7142) was adopted as a digital control board. The adopted FPGA board is shown in Figure 3 and its specifications are as follows.

- ADC : 125MHz max. sampling rate
  : 4 ch., 14bit resolution
- DAC : 320MHz max. converting rate
  : 1 ch., 16bit resolution
  : dc to 160MHz IF output
- FPGA : Xilinx Virtex4 XC4VSX55
- Memory : DDR2 SDRAM (64M×32)
- Clock : external or internal
- Gate : internal or external

Figure 3: Commercial FPGA board (Pentek 7142).

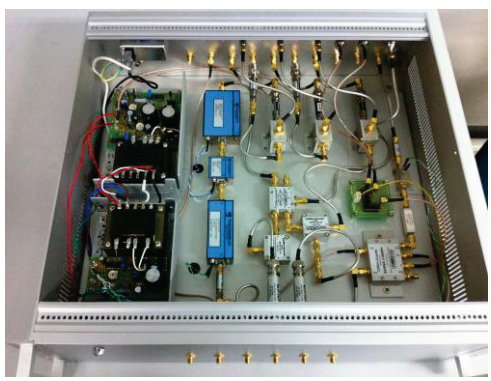

Figure 4: LLRF analog chassis.

Figure 4 shows the LLRF analog chassis. A 350MHz RF signal, a 300MHz LO signal, a 50MHz IF signal, and a 40MHz clock signal were chosen for the LLRF control system. Figure 5 shows the control racks including the LLRF control system at the klystron gallery.

A RF reference system distributing 300MHz LO signal to each RF control system has also been installed with a heating tape and a temperature control system at the klystron gallery.

Figure 5: Control racks including LLRF system.

Figure 6: Temperature-controlled RF reference line.

RF OPERATION

After the RF systems were installed, the RF system for the 20MeV linac has been operated for a beam

commissioning. Figure 7 shows the RF waveform at the 20MeV linac operation. Pulse width and rep. rate were 150us and 2Hz respectively.

The beam commissioning will start shortly, and the RF systems for 100MeV linac will be operated.

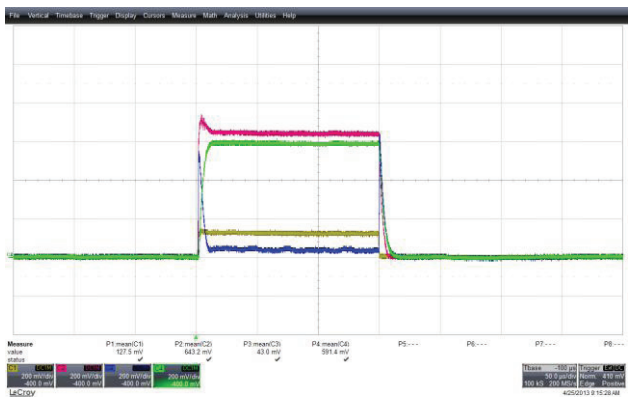

Figure 7: RF waveform at the RFQ operation (CH1: SSA, CH2: Forward RF, CH3: Reflected RF, CH4: Cavity RF power).

CONCLUSION

The RF systems for the 100MeV linac have been constructed. The HPRF system including klystrons, circulators, high power dummy loads, and waveguide components was installed at the klystron gallery. The LLRF control systems including a commercial FPGA module and a LLRF analog chassis were also installed. The RF system for 20MeV linac has been operated for a beam commissioning, and the RF systems for 100MeV linac will be operated shortly.

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