RF Operation for the 100MeV Proton Linac

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1. Introduction

The RF systems of the 100MeV proton linac for the KOMAC (KOrea Multi-purpose Accelerator Complex) were installed at the Gyeong-ju site. The 100MeV linac consists of a 3MeV RFQ, a 20MeV DTL with four tanks, two MEBT tanks, and seven 100MeV DTL tanks [1-2]. 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 [3]. The RF systems have been operated for the beam commissioning. The installation and operation of the RF system for the 100MeV proton linac are presented in this paper.

2. RF installation and Operation

The specifications of the RF system are summarized in Table 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 1 shows the RF systems installed at the klystron gallery, and Figure 2 shows the temperature-controlled RF reference line with heating tape.

The LLRF control systems and a RF reference system have been also installed at the klystron gallery. 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 [4]. A 350MHz RF signal, a 300MHz LO signal, a 50MHz IF signal, and a 40MHz clock signal were chosen for the LLRF control system. 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 2: RF systems installed in the klystron gallery

Figure 3: Temperature-controlled RF reference line

To check the phase stability of the RF reference line with temperature control, the S11 phase was measured with a shorting cap at the end of the line. Figure 3 shows the S11 phase measured at the RF reference line. The measured S11 phase was within +/-0.2 degrees, and they satisfy the requirements of the phase stability at the RF reference line.

The RF systems for the 100MeV linac have been operated for a beam commissioning. Figure 4 shows the RF waveform at the 20MeV linac operation. Pulse width and rep. rate were 150us and 2Hz respectively.

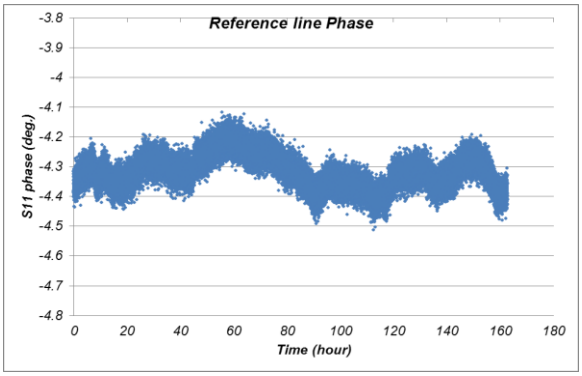

Figure 3: S11 phase measured at the RF reference line

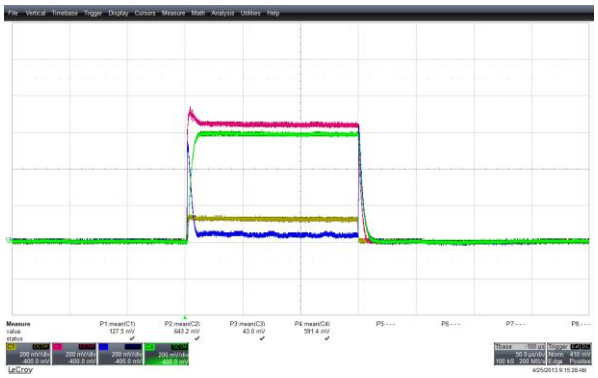

Figure 4: RF waveform at the RFQ operation

(CH1:SSA, CH2:Forward RF, CH3:Reflected RF, CH4:Cavity RF power)

3. Conclusions

The RF systems for the 100MeV linac were constructed. The HPRF system including klystrons, circulators, high power dummy loads, and waveguide components was installed at the klystron gallery, and the LLRF control systems including a commercial FPGA module and a LLRF analog chassis were also installed. The phase stability of the RF reference line was measured with S11 phase under temperature control. The RF systems for 100MeV linac have been operated for a beam commissioning, and the 100MeV proton beam has been supplied to users currently.

REFERENCES

[1] Y. S. Cho, et al.,"Status of 100-MeV Proton Linac Development for PEFP", in these proceedings.
[2] H. J. Kwon, et al., "Improvement of the 20MeV Proton Accelerator at KAERI", in these proceedings.
[3] Kyung-Tae Seol, Hyeok-Jung Kwon, Han-Sung Kim, Young-Gi Song, and Yong-Sub Cho, J. Korean Phys. Soc. **59**, 627 (2011).
[4] Young-Gi Song, Han-Sung Kim, Kyung-Tae Seol, Hyeok-Jung Kwon, and Yong-Sub Cho, J. Korean Phys. Soc. **59**, 577 (2010).