The low Level RF Control System of PLS-II Storage Ring at 400 mA 3.0 GeV*

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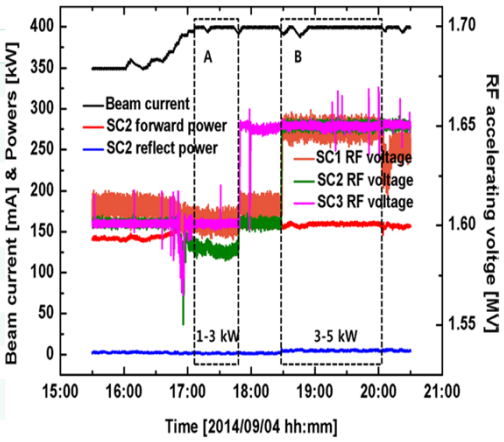
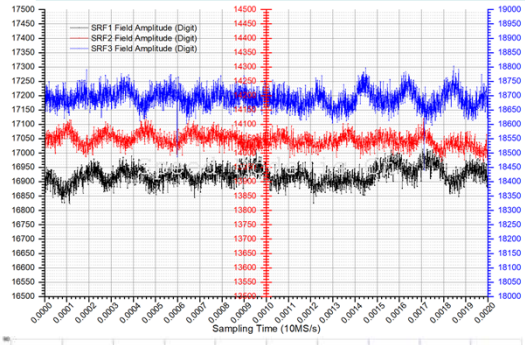
The RF system for the Pohang Light Source (PLS) storage ring was greatly upgraded for PLS-II project of 400mA, 3.0GeV from 200mA, 2.5GeV. Three superconducting(SC) RF cavities with each 300kW maximum klystron amplifier were commissioned with electron beam in way of one by one during the last 3 years for beam current of 400mA to until March 2014. The RF system is designed to provide stable beam through precise RF phase and amplitude requirements to be less than 0.3% in amplitude and 0.3° in phase deviations. This paper describes the RF system configuration, design details and test results. *** Supported by the Ministry of Science & ICT in Korea**

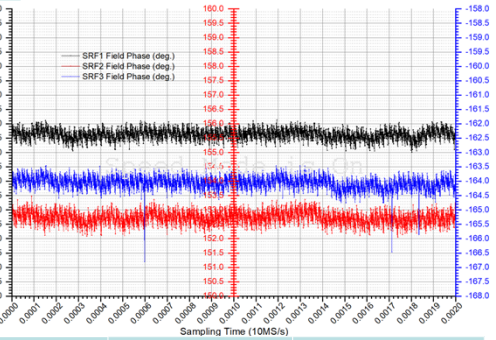
After three years of upgrading work, the Pohang Light Source-II (PLS-II) is now successfully operating. The final quantitative goal of PLS-II is a top-up user-service operation with beam current of 400mA to be completed by the end of 2014. Although available beam current is enhanced by setting a higher RF accelerating voltage, it is better to keep the RF accelerating voltage as low as possible in the long time top-up operation. We investigated the cause of the window vacuum pressure increment by studying the changes in the electric field distribution at the superconducting cavity and waveguide according to the beam current. The RF accelerating voltage of PLS-II RF system was set to 4.95 MV, which was estimated using the maximum available beam current that works as a function of RF voltage without stub tuners, and the top-up operation test with the beam current of 400mA was successfully.

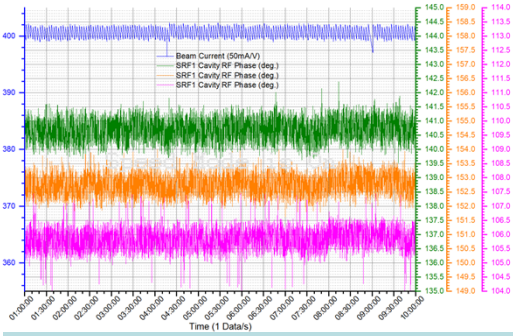
Operation parameter of the PLS-II SR

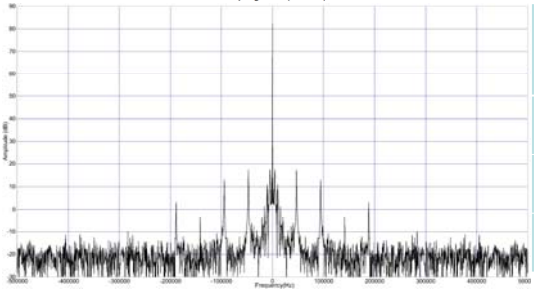
Parameter	Unit	Values
Energy	GeV	3
Beam Current	mA	400
Circumference	M	281.8
Emittance	Nm-radian	5.6
RF acceptance	%	2.8
Accelerator Voltage, Vacc	MV	4.5
Energy loss per turn	keV	1242
Harmonic Number		470
Momentum compaction factor	1.38X10E-3	
RF frequency	MHz	499.973





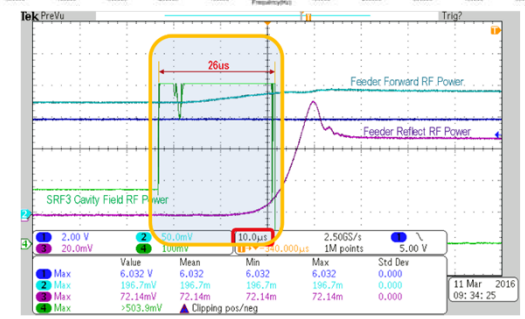




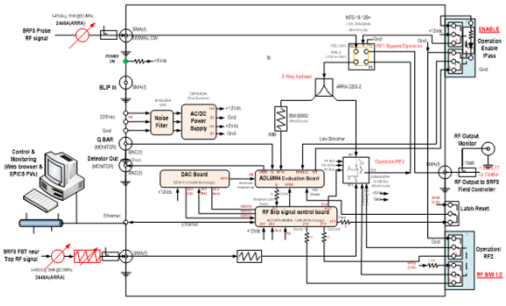


Electron Beam direction	Amplitude(rms)		Phase(rms)	
	Spec.	Measured (@9-hr)	Spec.	Measured (@9-hr)
Cavity1 (1st)	< 0.3%	0.18% (0.18)	< 0.3°	0.2(0.21)
Cavity2 (2nd)		0.17% (0.17)		0.23(0.18)
Cavity3 (3rd)		0.18% (0.04)		0.24(0.26)

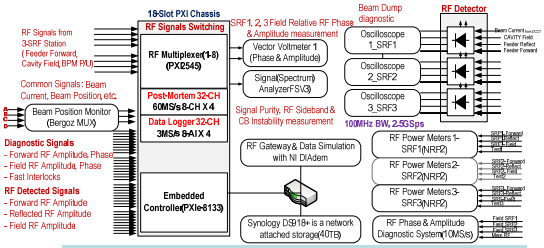
The cavity field maximum allowable errors and the measured rms according to 4.6MHz measurement bandwidth. With the loop closed we optimized proportional and integral gain by minimizing amplitude and phase noises. The optimized power spectral density of phase noise signal and its integrated RMS value measured for the superconducting cavity with 400mA electron beam. The amplitude, phase and RF carrier sideband performance were measured for three RF stations. Spurious signals were also observed between -60 to -65 dB relative to RF carrier. For 4.5MV (1.5MV/cavity) at 400mA at 3GeV in PLS-II storage ring the RF system performance was better than the required control specification



Third cavity signal fluctuated about 26us with very highly amplitude with the reflected power increasing. The probe blips happen with beam losing.



We are developing the controller for the cavity probe blip effect suppressing. When the blip happen the third cavity probe detected it is switch to the cavity's signal from the FBT near top (FBT) port to avoid a blip effect.



The diagnostics system include mainly three fast digitizing oscilloscopes configured to record RF amplitude, a PXI chassis with 32-CH 60MS/s digitizers and 4 8-CH Analog Data Acquisition modules (National Instrument). and the data storage devices with a 4-bay network attached storage solution equipped with a quad-core processor and 4GB DDR3L memory (Synology DS918+) and 4 20-TB Hard Disk Drives.

SUMMURAY

The RF accelerating voltage of PLS-II RF system was set to 4.5 MV(1.5MV/cavity) with stub tuners, which have been operate well using the available beam current that works as a function of RF voltage, and the top-up operation with the beam current of 400mA. The RF system performance was satisfied the required control specification. We will try to raise the operation availability as decrease beam losing probability using the controller for 3rd probe blip effect avoiding.