RF Signal switching system for electron beam position monitor utilizing ARM microcontroller

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1. Outline of UVSOR

Ultra Violet Synchrotron Radiation facility (UVSOR, Fig. 1 & Table 1) is a synchrotron radiation research facility at the Institute for Molecular Science(IMS).

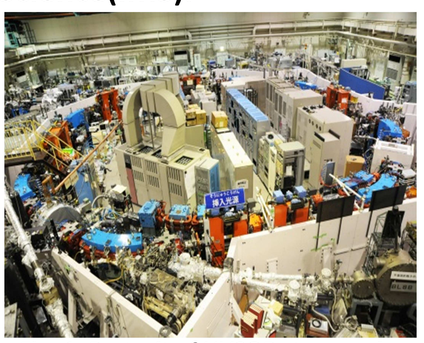


Fig. 1: Portrait of UVSOR storage ring

Table 1: Key parameters of UVSOR III

Electron Beam energy	750MeV
Circumference	53.2m
Straight Sections	4m X 4, 5m X 4
Emittance	17nm-rad
Energy Spread	5.4m X 10^{-4}
Betatron Tunes	(3.70, 3.20)
Momentum Compaction Factor	0.033
XY Coupling(presumed)	3%
RF Accelerating Voltage	100kV
RF Frequency	90.1MHz

2. BPM and Purpose of switching system

The storage ring of UVSOR has 24 BPMs (Fig. 2), each of which consists of 4 electrodes (Fig. 3).

To assist the commissioning procedure, we have developed a RF signal switching system controlled through LAN (Fig. 4).

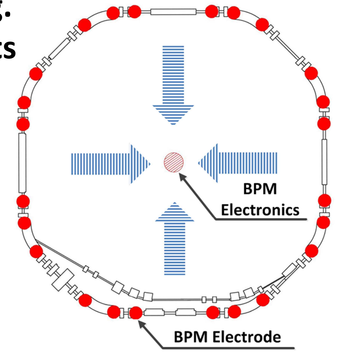


Fig. 2: Wiring diagram of BPM signals

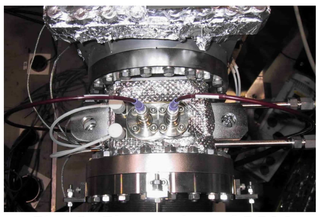


Fig. 3: Electrodes of BPM

Fig. 4: Photo of RF signal switching system(front view)

3. RF signal switching system

The RF signal switching system(Figs. 4 and 5) consists of a signal switching circuit with "mbed", FETs, and coaxial switches. By this system, we can select signals form 8 x 4 = 32 BPM signals to 1 x 4 = 4 BPM signals with coaxial switches of SPDT type and SP4T type.

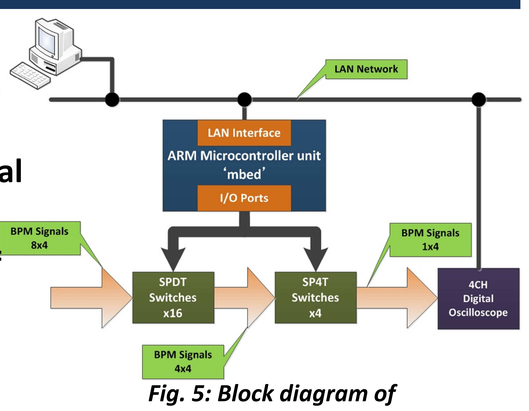


Fig. 5: Block diagram of RF signal switching system 1

4. Control "mbed" with "mbedRPC.js"

When we operate thecontrol application, the "mbed" responds as an HTTP server. At this time, "mbedRPC.js" which is built in the control application controls the I / O ports of the "mbed", and switches the coaxial switches(Fig. 6).

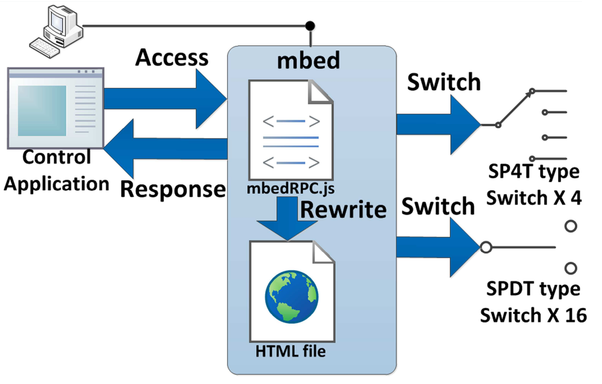


Fig. 6: Block diagram of RF signal switching system 2

5.Programming using "mbedPRC.js"

1. We include "mbedRPC.js" and define I/O ports.
2. We describe the operation buttons in HTML.
3. We describe the operation in JavaScript.
4. We write values for variables to read or write I/O ports.

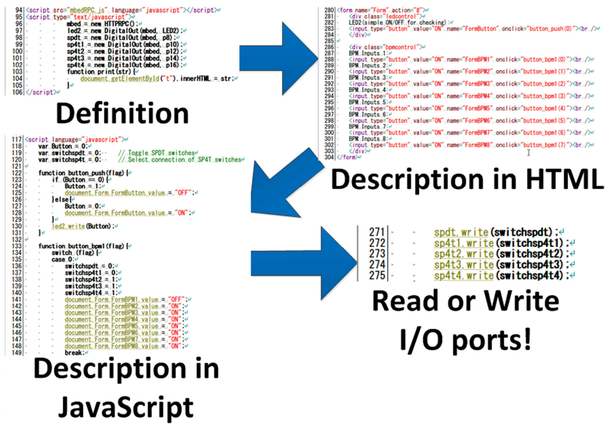


Fig. 7: procedures of programming

6. Performances

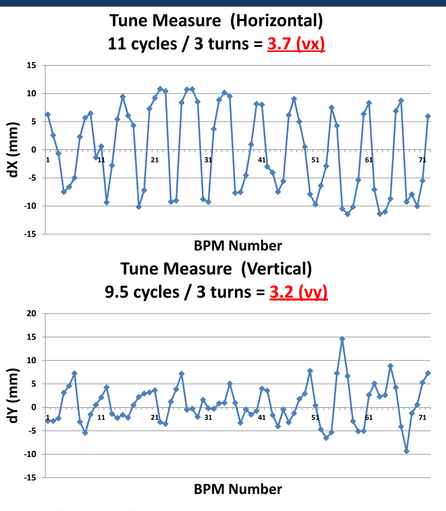
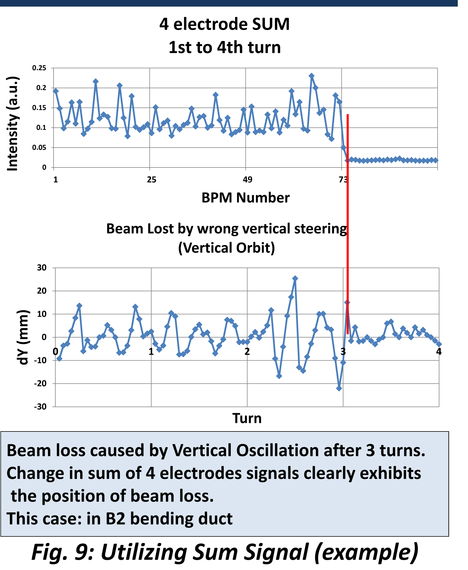


Fig. 8: Rough tune Measurement by Horizontal / Vertical Trajectory



Beam loss caused by Vertical Oscillation after 3 turns.
Change in sum of 4 electrodes signals clearly exhibits the position of beam loss.
This case: in B2 bending duct

Fig. 9: Utilizing Sum Signal (example)

7. Conclusion

1. We have developed the turn-by-turn BPM system as switching the BPM signals through LAN with coaxial switches and "mbed".
2. We could significantly reduce time and effort for circulating beam after the upgrading the storage ring.

8. Future plan

1. Improvement of accuracy by advanced data processing (pulse form fitting, etc.) and learning LPC1769 (Fig. 10)
2. Easy swap between Ordinary BPM (Bergoz. Co.) and TBTBPM (extended switcher system)
3. Automatic BPM switching, data acquisition, and data processing)

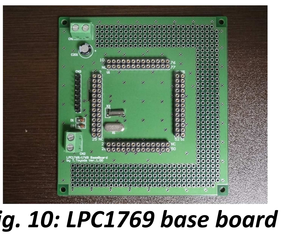


Fig. 10: LPC1769 base board