Construction of the Control System for the SPring-8 Synchrotron

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1. Introduction

The construction of SPring-8 booster synchrotron is finished successfully at September of 1996[1]. The development of the synchrotron control system has been started since 1993. The control system[2] is consisted of two parts, one is the device controllers with the VME systems and the other is the main computer with workstation which performs man-machine interface and data acquisition, as shown in Fig. 1. The VME systems and the workstations are connected by Ethernet. The details of the workstations are described in other sections in this annual report. There are 14 VME system running OS-9. This system was adopted in order to carry out data collection and processing in real-time. The basic system consists of MVME147SA-1 CPU, Ethernet I/O, DI, DO, RAS and a various modules. The starting method of the VME systems is BOOTP from the synchrotron computer. The communicative between the synchrotron computer and the VME systems is regulary carried out.

2. RF

The RF control system has two VME's. One controls two 1MW klystron and RF low power circuit[3]. The other controls the tuners and supervise the vacuum control system of the RF cavities. The RF control system is required to select some acceleration-voltage pattern in the condition of the synchrotron operation. For example, the effective acceleration-voltage is changed following the beam energy between 8MV at the beam injection of 1GeV and 18.7MV at the full energy 8GeV with a repetition cycle of 1Hz. After the acceleration-voltage pattern decided, it is converted to the phase difference pattern between two klystrons automatically. The acceleration-voltage pattern are generated with the pattern memory modules (PMEMA1/PMEMB1/ PMEMC1) of the VME system, which is a digital I/O board, clock frequency of 10kHz. It is possible to set the acceleration-voltage pattern visually on the display of the workstation.

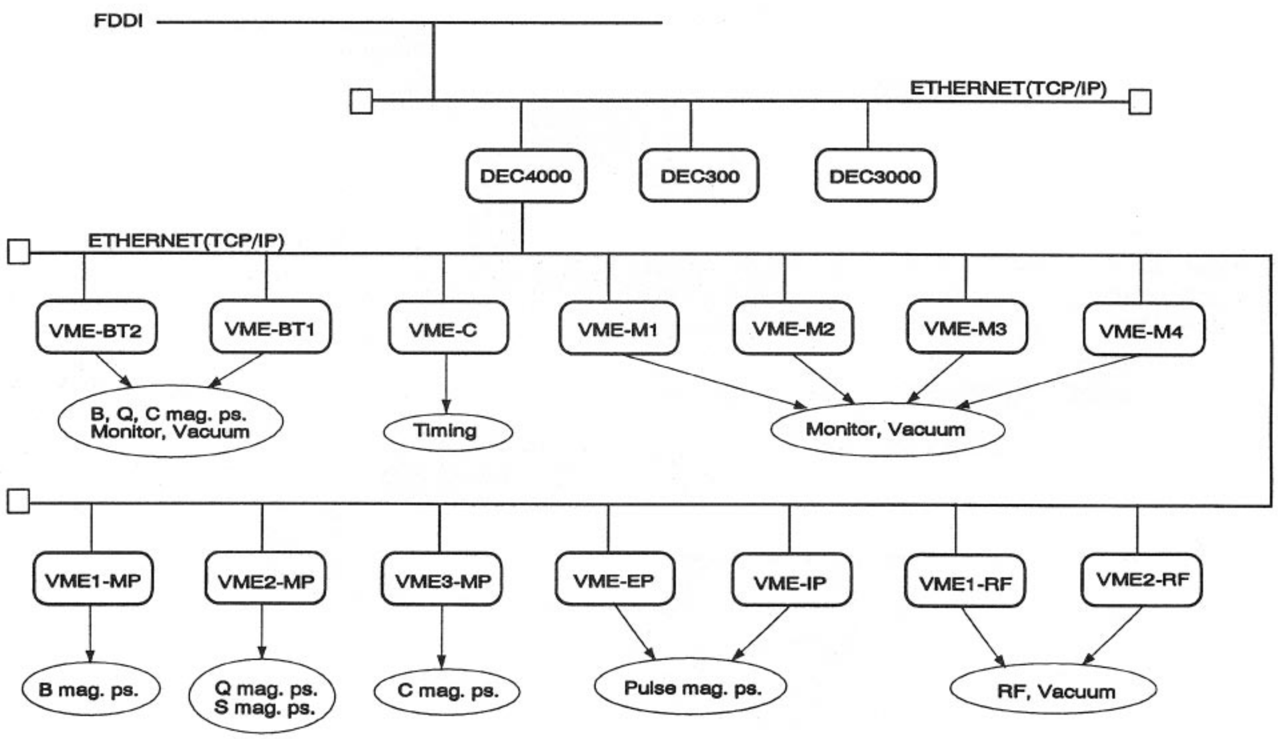

Fig.1 Hardware composition of the synchrotron control system

3. Magnet Power Supply

The synchrotron lattice magnets of the BM, QF, QD, SF and SD have two VME's that have to be ramped with the beam energy ramping, which magnets are excited by five power supplies[4]. The excitation current patterns of the magnet system are designed to be trapezoid ones as shown in Fig. 2. The current patterns are generated with the FDO (MVME56000) of the VME system, which is a very fast digital I/O board, clock frequency of 10kHz. It is possible to set the current patterns visually, and the output currents can be confirmed on the same display of the workstation.

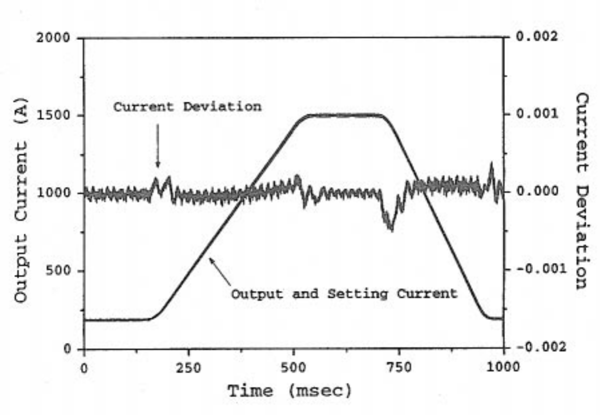

Fig. 2 The relation between setting current and output cureent. The output current figure overlaps with the setting one. "Current deviation" is the amount of subtract setting current form output current. The value is normalized by the maximum current. The strength of the current deviation is satisfied the requirement.

The synchrotron correction magnets of the CH, CV have one VME's. The VME system and the power supplies are connected with the network I/O system using HDLC protocol. The VME system has the communicative modules with the synchrotron computer which are called NIO-C (HIMV-520) and the optical signal brancher which are called NIO-BRANCH (HIMD5213). Each power supply has network I/O board, which is called NIO-SLAVE (HIMD5211), and it is connected with the NIO-C through the NIO-BRANCH.

The pulse Magnets which is composed of seputum, kicker and bump maganets have two VME's. One contrals two seputum magnets and two kicker magnets in order to inject the electron beam of 1 GeV from the linac. Other control three kicker magnets, four seputum magnets and four bump magnets in order to extract the electron beam with 8 GeV from the synchrotron.

4. SSBT

The synchrotron to storage ring beam transport line (SSBT) control system have two VME's. This system mainly controls the power supplies of dipole, quadrupole, correction magnets, the beam diagnostics and the vacuum system. The VME system and the power supplies are connected with the Message Tree using SDLC protocol. The VME system has the communicative modules with the synchrotron computer which are called Message Tree Communicator (MTC) and the optical signal brancher which are called Message Tree Brancher (MTB). Each power supply has remote I/O device, which is called Universal Device Controller (UDC), and it is connected with the MTC through the MTB.

5. Vacuum

The vacuum control system of synchrotron and SSBT are consisted with the VME's, the vacuum controllers and the vacuum apparatuses. The vacuum controller, which was named vacuum pump station (PST), were newly developed. The PST has CPU, EP-ROM sequencer and relays. Twenty-three PST's are connected to the VME's with optical GB-IB bus, and supervise vacuum exhaust pumps, vacuum gauges, and vacuum valves. When the deterioration of vacuum (< 1 [Pa]) is occurred, the PST's command to close the ring vacuum gate valves by hardwired interlock system.

6. Beam Diagnostics

The beam diagnostics of synchrotron and SSBT are composed of BPM[5], DCCT, FCT, SCM and RF-KO. The system of synchrotron has four VME's and the system of SSBT are used the VME's of SSBT control system. The VME is not only executes I/O, but also the measurement of BPM and DCCT is carried out. In case of BPM, the data from signal processing circuits are stored in the VME's, and are transmitted to the synchrotron computer. The beam position is calculated with the polynominals which have been obtained by calibration.

References

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