Upgrade of the RF Control System in BEPC

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1. INTRODUCTION

The Radio Frequency (RF) system is an important part of the Beijing Electron-Positron Collider (BEPC). It is used to accelerate the beams and maintain the energy of the electrons and positrons in the storage ring. Its correct operation is a precondition for the injection and storage of the beams.

Until February 1992 the BEPC RF system consisted of two cavities and the power for each cavity was supplied by four RF amplifiers. To improve the peformance of the collider and to meet the requirements for the luminosity upgrade, the RF system will be expanded by adding two more cavities and re-arranging the RF system. Instead of one cavity being powered by four amplifiers, in the new arrangement the amplifiers will be re-connected so that each cavity will be powered by two amplifiers. As a result, an upgrade of the RF control system becomes necessary, since its design is based on the two cavity mode and it cannot be extended to adapt to the new requirements.

The RF control system is required for switching the stations on and off, conditioning the RF fields in the cavities, logging of RF parameters and status, monitoring the state of local interlocks etc. The numbers of different control and monitoring points for an RF local station are shown in Table 1.

Type	DM status	ON/OFF control	Analog monitor	Analog control
Number	128	24	32	4

Table 1. Numbers of control points

After the upgrade, the RF control system can be divided into three levels: the Central Control level, the Local Control level and the Equipment level, as shown in Fig. 1.

2. CENTRAL CONTROL LEVEL

At the Central Control level, a VAX 4500 has been used as the host machine which controls all the local stations. A unit type 3922 serves to connect the VAX to a 2922 module in a CAMAC system crate. The CAMAC crate contains a Serial Branch Driver (SBD) with an Optical Data Link (ODL) module for each of the local stations.

3. LOCAL CONTROL LEVEL

The local control stations are situated close to the equipment to be controlled for convenience in connection, testing, conditioning and maintenence. At this level, the RF intelligent controller and the Programmable Logic Controller (PLC) form the kernel of the upgraded RF control system.

i. The connection between the Central Control level and the Local Control level.

Very strong RF and electromagnetic interference is caused by the high power equipment at BEPC. Therefore optical fiber data links are used for the connections between the Central Control level and the Local Control level. ODL modules, operating at 5 Mbit/s, have been developed at BEPC and are used for the CAMAC serial highway.

ii. RF local station CAMAC crate.

High performance CAMAC modules based on function are used. In this way, the number of types of modules is kept to a minimum and the design of the applications software for the local stations is simplified. Four types of general purpose modules are used. These are a 32-channel digital input module

(IDIM), a 32-channel digital output module (IDOM), a 32-channel smart analog input module (SAM) and a 16-channel high precision analog output module. A3 and A4 are input and output isolating amplifiers.

iii. RF intelligent controller and PLC

The RF intelligent controller is the major part of the upgrade and was designed and constructed at BEPC. There is one controller for each cavity. It is based on the 8031 single-chip microcomputer. It it deals with the signals of the control system and provides the following:

- on/off control of the low and high voltage supplies for the two RF amplifiers for each cavity
- analog signal input and display
- signal interlock and control of each cavity
- crucial signal aquisition and display

The schematic diagram of the RF controller is shown in Fig. 2

This, together with the PLC, also provides local manual control facilities. This facilitates testing, debugging and maintenance. The PLC manages the interlock logic so that, for instance, if the vacuum deteriorates in a cavity, it passes the information to the RF controller and the amplifier will be shut down. It takes into account several conditions and makes the appropiate decision. It also send signals to status and temperature displays.

4. EQUIPMENT LEVEL

At this level, the analogue and digital signals from the upper layers are received and acted upon and the required signals returned to the upper levels.

5. CONCLUSION.

The design of the local control station was started in February 1992 and the equipment was installed in October 1993. Since then, it has operated stably and reliably.

ACKNOWLEDGEMENT.

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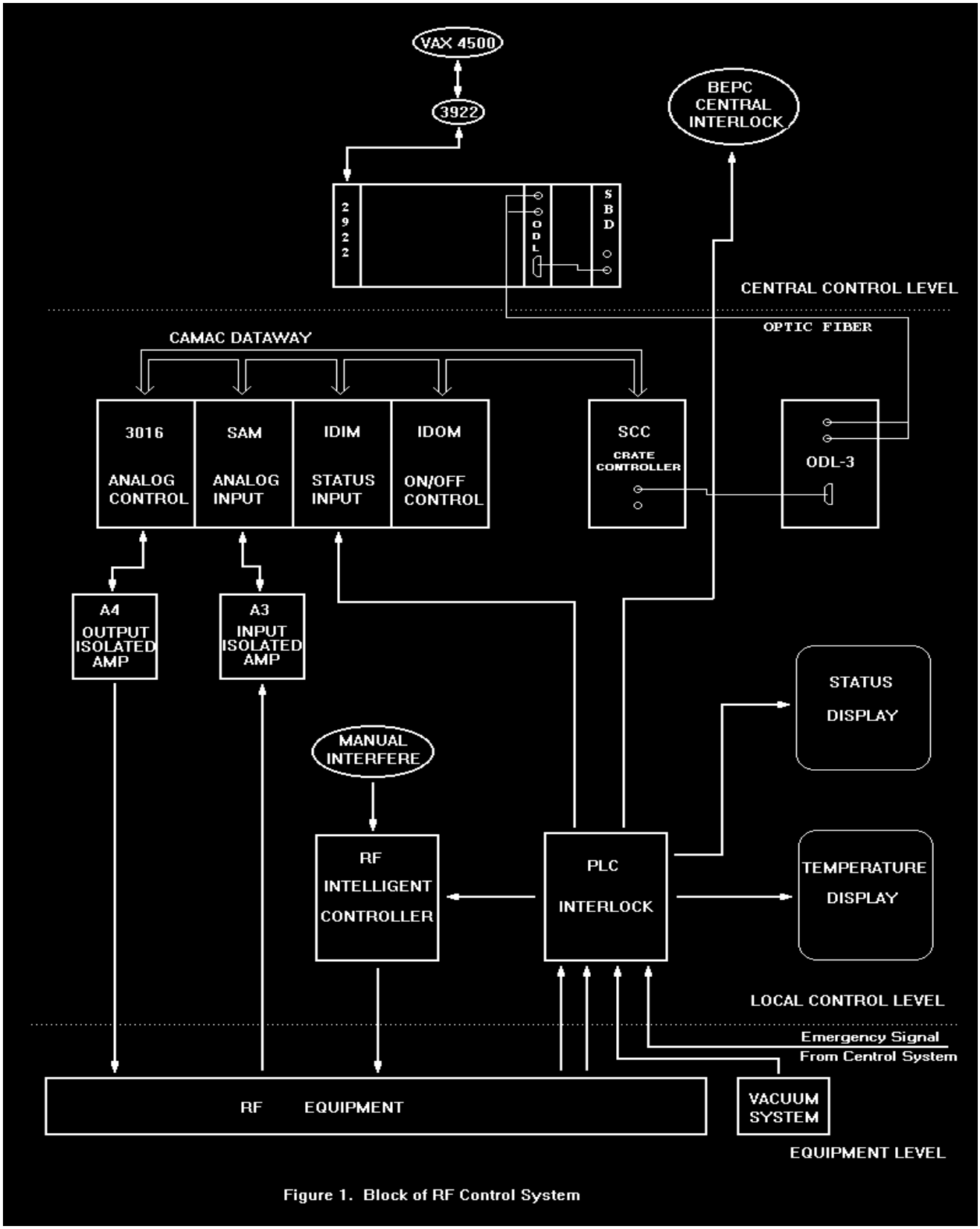

Figure 1. Block of RF Control System

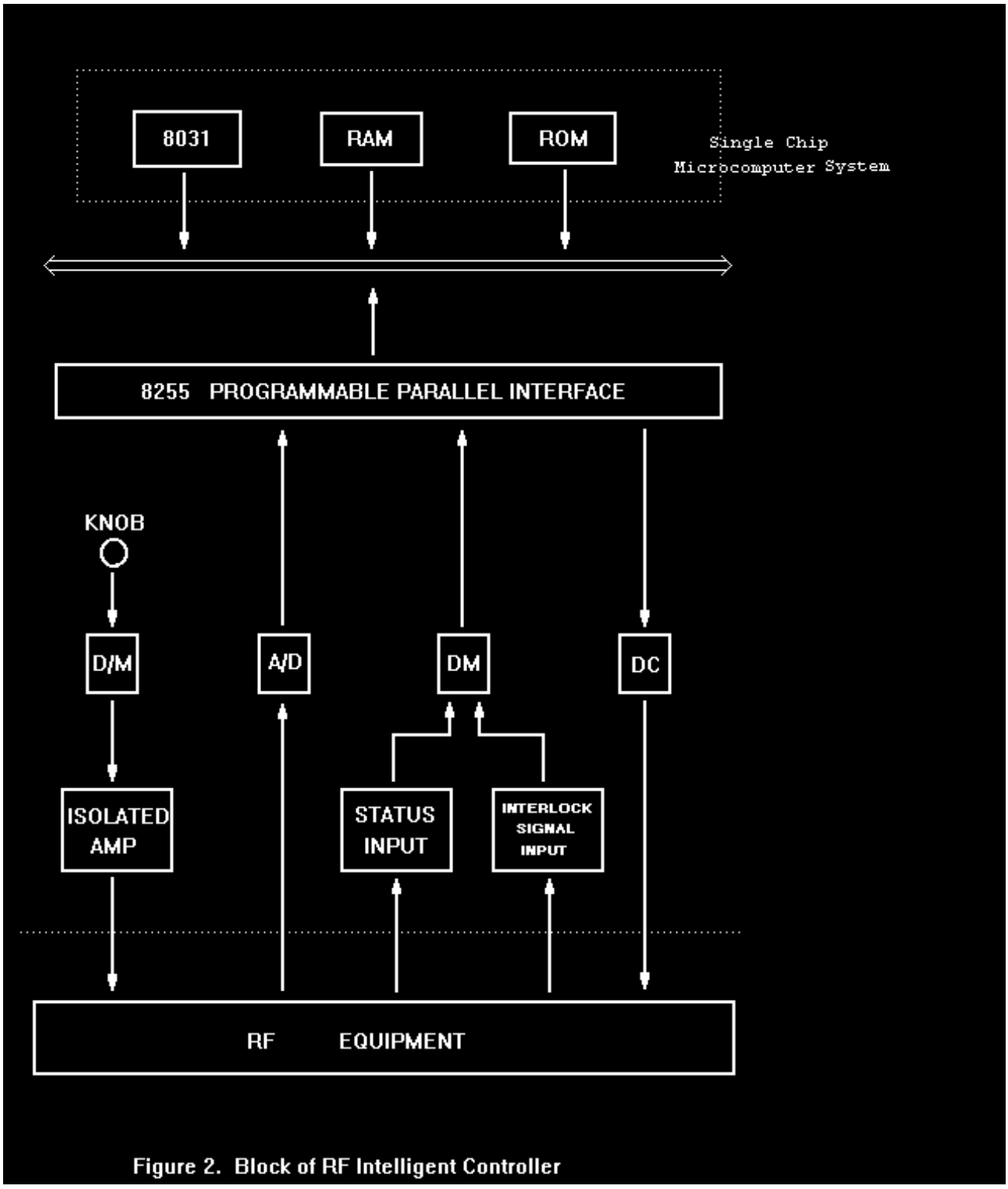

Figure 2. Block of RF Intelligent Controller