BNL-105254-2014-TECH

Booster Technical Note No. 210;BNL-105254-2014-IR

BACKUP OF THE BOOSTER GAUSS CLOCK

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July 1992

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U.S. Department of Energy

USDOE Office of Science (SC)

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July 22, 1992

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1. Introduction

The Booster Gauss Clock is described in reference 1. Its relation to the Booster Gauss Line generator has been described in references 2 and 3. Because the Gauss Clock and the Gauss Line will become crucial to the operation of Booster equipment it is necessary for a backup Gauss Clock to be available for testing and development when the Booster Main Dipole is not being operated. The purpose of this draft is to propose a scheme for generating a Backup Gauss Clock and to solicit input on the functionality and operating parameters of its use.

2. Functionality

The Booster Backup Gauss Clock (BBGC) should provide an accurate simulation of the representation of Booster Dipole magnetic field cycles as up/down magnetic field counts to allow users to verify operation of devices using Gauss Line signals. In particular, it should provide Pulse to Pulse Modulation (PPM) facilities to the four logical users who may be operating Booster systems at any one time. As envisaged at present there are only two direct users of the Gauss Clock, the Gauss Line Generator and the RF Beam Control system. Other magnetic field sensitive devices will operate from Gauss Line encoded signals. In any case it seems advisable to insert the BBGC at the earliest practicable level in the system to maximize its capability. The BBGC should be highly reliable and independent of the equipment for whose function it is to substitute. Attention should be paid to the relation between BBGC cycles and recent Booster operating parameters. A clear distinction must be made between the backup function and test functions which might bear no relation to actual accelerator operating conditions at a given time, e.g. testing heavy ion cycles while running protons etc. It is proposed that the BBGC be implemented as strictly a backup device and that incompatible testing be achieved by other means. This would apply to normal running. During shutdowns the BBGC could be allowed to produce test functions.

3. Proposed Simulation Scheme

It is proposed that the BBGC be implemented as an extension of Booster Main Magnet Power Supply (BMMPS) control. The existing BMMPS control program produces a representation of the magnetic field B as a function of time for one to four PPM users. A simple extension of the Data Base and suitable additions to the hardware will permit a vector function generator output of B as a function of time. Further, the vector function is generated via up and down clocks whose frequency is actually proportional to the time derivative of B, i.e. they are analogous to BGC up and down counts. By modifying the vector amplitude hardware these clocks could be made available externally where they could directly substitute for the BGC. (Incidentally, this method partially avoids the

16-bit limit which would constrain the amplitude or resolution in an amplitude rather than a derivative implementation.)

4. Operational Procedure

When a magnetic field function is selected for a PPM user in the MMPS application program, the field function would be loaded to appropriate hardware to produce the scaled function at 0.1 gauss per count. Conventional PPM operation would then produce this output as called for by the Super Cycle Generator. The output of up or down counts would be in parallel with BGC operation and would be unused under normal circumstances. When the dipole operation ceases, the gauss clock output would be switched to the backup mode and a BGC output completely analogous to the real function would be produced. For deliberate actions, this switch could be under control of an application program or operator. Automatic switching, if provided, would require suitable detectors and control. The functions of such devices need analysis and specification.

Additions to the MMPS program are required since the procedure for the BBGC is almost the inverse of the power supply control, i.e. the BBGC is required when the power supply is inoperative. Similar questions with respect to initialisation must be addressed.

5. Hardware

The hardware required to implement this proposal consists of, minimally, a vector amplitude board with suitable power and timing support and a multiplexer to select between real and backup gauss clock counts. Some relevant considerations are:

(1) The timing for the BBGC corresponds to that for the Booster MMPS so that its timing board could be shared if other criteria permit. Otherwise a copy of MMPS timing would be loaded to some other timing board.

(2) Vector boards are installed in remote crates of Eurocard format. While space is available in the BMMPS equipment, it must be recognised that the unavailability of that equipment may be the reason for switching to the BBGC. Greater independence is probably desirable.

(3) The similarity of the requirements of the BBGC and the BMMPS suggest use of the same device controller. This may be acceptable since the device controller is rather independent of the power supply. If a separate device controller is desired, an independent system of device controller and remote crate would be required. The Gauss Line device controller is a possible candidate for this function.

References

(4) J. Geller, Booster Technical Note #175

(5) B. Culwick, Memorandum: The Booster Gauss Clock 12/8/89

(6) B. Culwick, Memorandum: Booster Gauss Line Generator 12/27/89