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A BOOSTER TIMING SYSTEM

A timing system for the booster is described in this note. This is a computer based digital system for producing the required digital commands and timing pulses to operate the booster and its interfaces with the linac and main ring.

The computer is a small control computer of which many are commercially available. The computer is fully occupied with its control functions and receives input from other digital systems, the main control room, and local operator intervention. During acceleration, its only activity will be transmitting commands. During the falling field, it will accept external commands and prepare tables for the next cycle.

The general system layout is shown in Figure 1. This system is similar to the "programmer" used at the ZGS with two primary exceptions. First, the programmer was built entirely in-house. The control computer art has advanced to the place where most of the system can be within a commercially available machine. This reduces engineering costs and increases flexibility. Second, there will not be the need for switching clocks. Since there are no flat tops in the booster cycle, there is no need for real time clocks. The machine will operate entirely on "magnetic time."

Timing Accuracy

The linac momentum spread is less than $\Delta p/p = \pm 0.8 \times 10^{-3}$. The error in injection field then should be negligible in relation to this say $\Delta B/B < \pm 1 \times 10^{-4}$. The injection field is about 500 gauss, therefore, the injection field should be reproducable to ± .05 gauss. The absolute accuracy can be considerably poorer since these parameters will be tuned using the beam anyhow. At extraction the momentum spread of the booster is about $\Delta p/p = \pm 1.0 \times 10^{-3}$. The required reproducibility should again be $\Delta B/B < \pm 1 \times 10^{-4}$ which corresponds to $\Delta B <$ ± .8 gauss. For ease of operation, the resolution of the B counter will be .1 gauss throughout the cycle.

The maximum dB/dt = 370 kg/sec which corresponds to 3.7 MHz for the maximum B clock frequency. The system will not be able to transmit pulses on two successive clock pulses at maximum dB/dt. The system will be able to transmit successive pulses as close as 5 μsec.

The computer will directly transmit parallel words to a number of devices timed by interrupts from the timing matrix. The computer can update the tables of values during the decreasing field when there is no beam in the machine.

A B reference pulse is needed to keep track of the digital integrator drift. At B reference the B register is sample The computer compares this number with the desired number and introduces an offset

in the integrator to compensate the natural drift. The B reference pulse needs a reproducibility of better than ±.05 gauss at about 500 gauss.

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