Development of Septum Magnets for the SPring-8 Synchrotron

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1. Introduction

In the Synchrotron, there are six septum magnets ; two for injection and four for extraction. The second septum magnet and the third one were made, the magnetic field distributions and the wave forms of magnetic field ware measured.

All results of the measurements meet the specification.

2. Septum Magnets

The required characteristics of the second and the third septum magnet for beam extraction are shown in Table1.

Table 1. Characteristics of the septum magnets for beam extraction

	2nd Septum Magnet	3rd Septum Magnet
Effective length	0.400 m	1.1105 m
Number of turns	1	4
Current wave form	half-sinusoid	half-sinusoid
Pulse width	0.1 ms	2.5 ms
Magnetic field strength	0.3442 T	1.225 T
Leakage magnetic field	3.0E-5 T	2.0E-4 T
Deflection angle	4.95 mrad (at 0.33T)	45.78 mrad (at 1.1T)
Shield Material	copper and iron	iron
Resistance	1.8 mΩ	16.1 mΩ
Inductance	2.1 μH	106.1 μH

i) Second Septum Magnet

The required strength of magnetic field is 0.3442 T and the aperture is 8 x 27.8 mm^2.

Both the septum coil and the return coil are made from 1.5 x 11.3 mm^2 and 6.5 x 20.0 mm^2 OFHC(Oxygen Free High Conductivity) copper block. A copper coil holder fixed to a yoke holder supports the septum, and becomes a magnetic shield by an eddy current. The septum coil and the return coil are insulated a kapton tape of 0.05 mm thickness. The heat produced of the coil is removed through a cooling pipe. It is attached to the yoke holder.

The current wave form is a half of the sinusoidal wave of 0.1 msec full width and the peak current is 2,200 A.

ii) Third Septum Magnet

The configuration of the magnet is shown in Fig.1. The required magnetic field is 1.225 T and the aperture of the magnet is 9 x 41.3 mm^2 area.

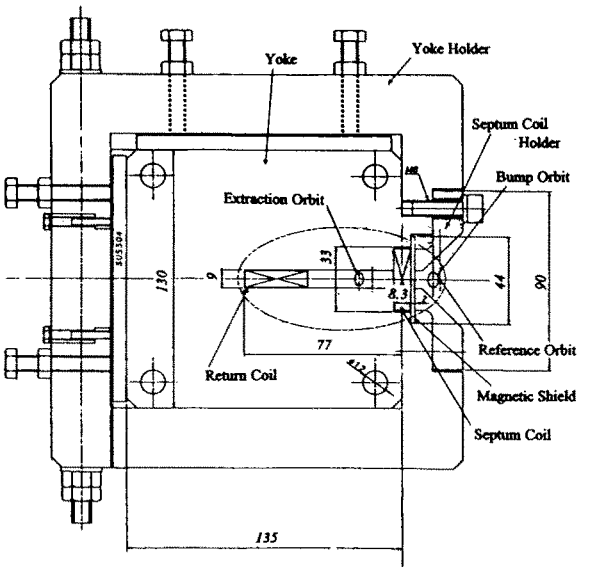

Fig.1. The configuration of The Third Septum Magnet

Both the septum coil(30.9 x 7.8 mm^2) and the return coil(7.8 x 30.9 mm^2) are made of the OFHC hollow conductor (4 turns-7.4 x 7.4 mm^2) which is used as the direct cooling water.

The septum coil is attached by stainless steel to an iron plate which is fixed to the yoke holder and also works as a magnetic shield.

The current wave form is a half of a sinusoidal wave of 2.5 msec full width and the peak current is 2,200 A.

3. Conclusion

It was confirmed that the specification was satisfied for both the second and the third septum magnet. We are already making another septum magnets, based on these preceding septum magnets.

electron beam from the gun was measured by the wall-current monitor. One standard deviation of the jitters was 30 psec. This value meets the specification of the transfer line.

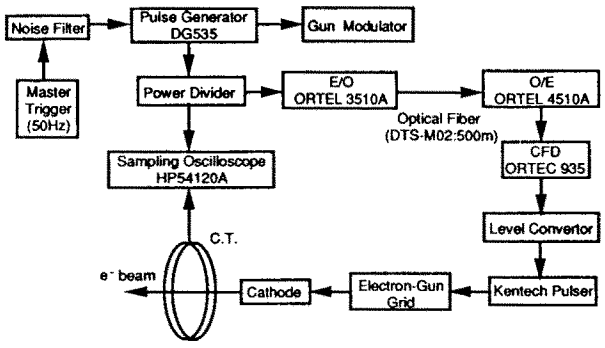

Fig.2 The block-diagram of the timing system

3. 508.58-MHz Preset-counter

To generate the master pulse for a single -bunch beam-operation, a 508.58-MHz preset-counter was manufactured and tested. Figure 3 shows the block-diagram of the measurement system. The RF signal of 254.29 MHz was entered into one preset-counter and the RF signal of 508.58 MHz was entered into the other preset-counter. These preset-counters generate one pulse per 1218 and 2436 counts, respectively. The duration of these output pulses are constant (4.79 μ sec) and the timing between two pulse trains is also constant, if the preset-counters do not miscount the RF signals. Any change in this timing was not found in a continuous operation of 22 hours, this showed that there was no error in counting of RF signals.

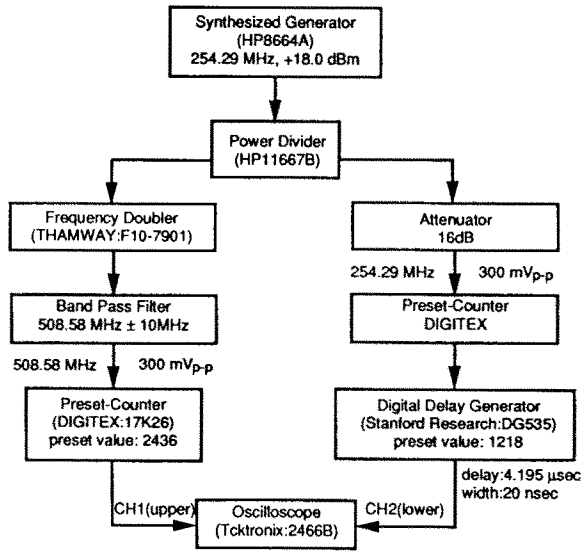

Fig.3 The block-diagram of the 508.58-MHz-preset-counter measurement system

4. Conclusion

The optical fiber, the EO/OE and 508.58 MHz preset-counter for the transfer line of RF and the timing signals were tested and it proved that the components meet the specification of the RF and timing system.