1.3 GeV Electron Synchrotron

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Abstract

The performance of a *1.3 GeV electron booster synchrotron* installed at SRRC, Hsinchu Taiwan R.O.C. is described. The system comprises a 140 keV gun, a 50 MeV linac and a 1..3 GeV 10 Hz synchrotron. Beam performance: Multibunch mode > 20 mA 200 ns pulse single bunch mode > 50 mA 1.8 ns. It was commissioned in June 1992.

I. INTRODUCTION

In 1988 Scanditronix received an order for a *1.3 GeV Electron beam injector system* for Synchrotron Radiation Research Center Taiwan. The order was for a turn-key system including a 50 MeV Linac as preinjector. The RF-system was built by the SRRC RF group.

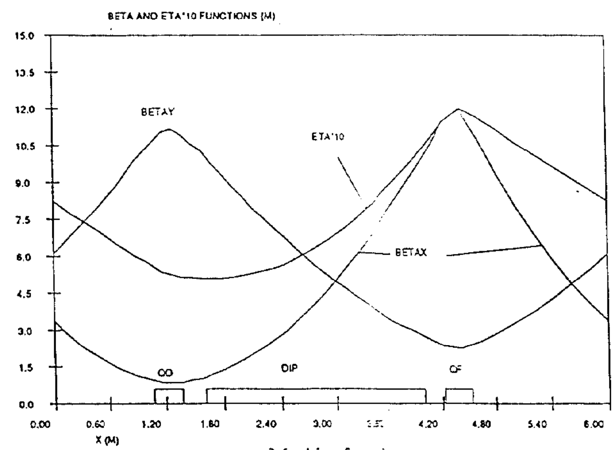
II. PARAMETER LIST

The most important synchrotron parameters are summerized below. [1]

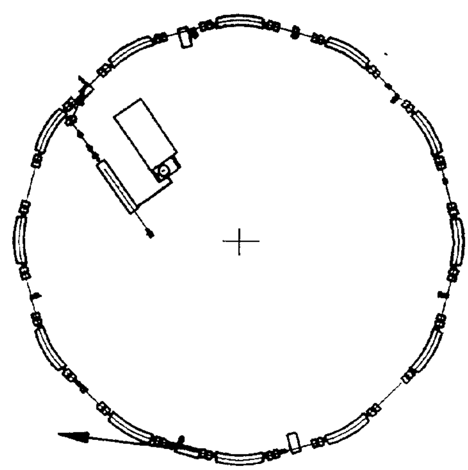
Max energy	1.3 GeV
Circumference	72 m
RF-freq.	500 MHz
Hor. emittance	$3 \cdot 10^{-7}$ mrad
Energy spread	$2 \cdot 10^{-3}$
ß x max	11.97 m
ß y max	11.04 m
η max	1.20 m
Hor nat chromaticity	-5.65
Vert nat chromaticity	-3.67
Momentum compaction factor	0,058
Multi bunch	
Pulse length	100 ns min
Current	5 mA
Single bunch	
Pulse length	< 2 ns
Current	40 mA

III. LATTICE

The lattice is of FO DO type. It consists of twelve cells. Each cell consists of one dipole, two quadrupoles and two sextupoles. The betafunctions are shown in the following figure.



Machine functions.



IV. PREINJECTOR

The preinjector consists of a 140 kV gun, SLAC type, and a 50 MeV Linac structure delivered by HRC [2]. The specification for the Linac system:

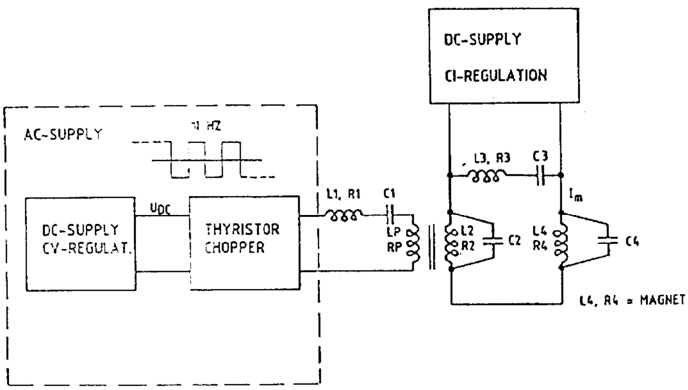
Energy	50 MeV
Frequency	2997.9 MHz
Multibunch	
Pulse length	< 500 ns
Current	30 mA
Single bunch	
Pulse length	1.8 ns
Current	220 mA

V. INJECTION

The injection is single turn. A twenty degree septum magnet in one straight section positions the beam on axis on the following straight. At the crossing point an extremely test kicker, less than 50 ns fall time, kicks the beam on orbit.

VI. MAGNET SYSTEMS

Three separate White circuits are used. One for the dipoles and one each for quadrupole families. The principle diagram for the White circuits is shown below. The AC-supplies is of the GTO type.



	DQ	FQ	Dipole
DC-current	90 A	145 A	1070 A
AC-current	22 A	70 A	540 A
Magnet peak current	162	257 A	1920 A
Tracking	$< 3 \cdot 10^{-3}$		

VII. EXTRACTION

Three bumper magnets in adjacent cells creates a local bump at the extraction septum entrance. A fast kicker, less than 50 ns rise time, kicks the beam across the septum. The timing of the extraction kicker is synchronized to the injection kicker. In that way the gap in the bunch train caused by the injection kicker fall time is used for the extraction kicker rise time.

VIII. MEASUREMENTS

All designed parameters have been achieved and some generously exceeded dc.

At the exit of one of the dipoles a mirror is placed looking upstream. The light from the dipole is with some optics fed to a CCD camera. The CCD camera can be triggered at any time during the ramping. Assuming that the ß-functions are correct the emittance and energy spread can be calculated. This measurements are described in [3].

The extracted pulse in the long pulse mode has been measured by three independent methods; a Faraday cup, a Bergoz Fast Current Transformer and a Q-electrode. The short pulse was measured by a Faraday cup, a Q-electrode and a fast ceramic gap.

	Specification	Design value	Measured
Emittance	$3 \cdot 10^{-7}$	< 1	1.5
Energy spread	$2 \cdot 10^{-3}$	0.5	1
Long pulse			
Pulse length	100 ns	200 ns	200 ns
Current	5 mA	> 5 mA	20 mA
Short pulse			
Pulse length	2 ns	2 ns	2
Current	40 mA	40 mA	> 55

IX. ACKNOWLEDGEMENT

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The collaboration with the RF group from SRRC has been very good.

X. REFERENCES

[1] Conceptual Design Report for the 1.3 GeV Booster, Scx AB.

[2] J. Haimson, B. Mecklenburg
Proc. PAC 1991 Page 3183

[3] K.K Lin, K.T. Hsu, T.S.Veng
Measurements on the SRRC 1.3 GeV booster, this conference.