New Transverse Feedback Kicker System in the Positron Intensity Accumulator (PIA) Ring

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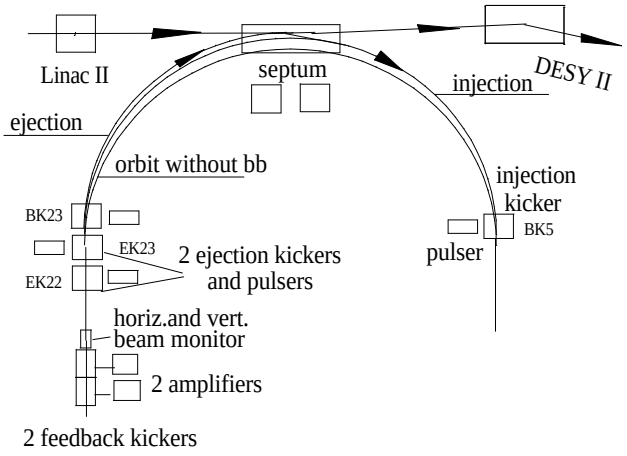
Abstract

Kickers for transvers feedback systems operate in the PETRA, Doris and the HERA elektron and proton storage rings. We have now installed a new system in PIA.

A beam position signal which is processed elektronically drives the two kickers via one amplier each (1 kW).

This report shows the kickersystem, the design and the amplifier data. Ferrites in the kicker are used to guide the magnetic field. The kicker is designed for a characteristic impedance of 50 Ω, to achieve a broad band device with a frequency range of
0.3--10 MHz.

PIA with feedback kickers



2 Aspects of Kicker Design

The following ideas must be mentioned:

The deflection angle at 450 MeV.

The field build up and fall time between bunches.

The use of ferrite for field guidance and induction savings.

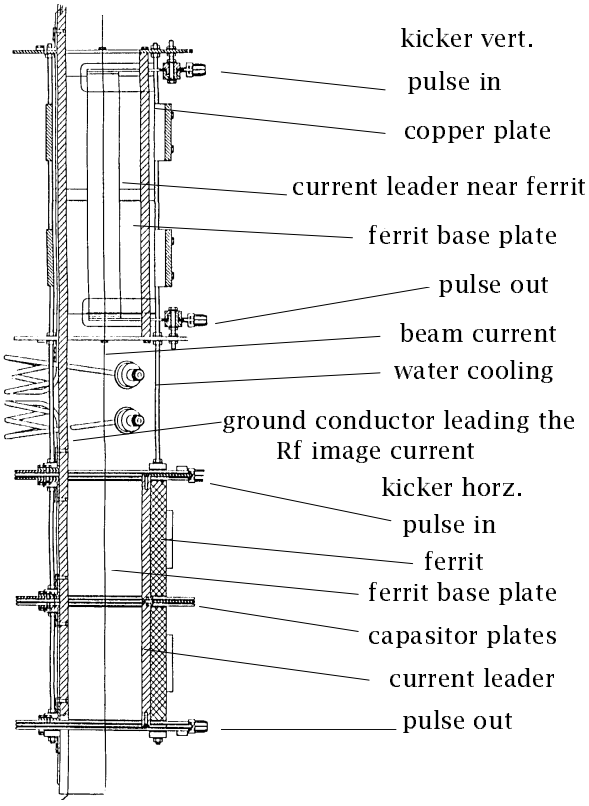
The nessecity of a copper conductor through the kickers due to RF image currents induced by the beam.

The design of the kickers for a characteristic impedance of 50 Ω in order to achieve a broad band kicker, without large phase rotation between the drive and the kicker field, with the ability to work with a low cost transmitter.

2.1 Kicker Data

		horz.	vertical.
Energy	MeV	450	450
B x l	Tm x 10^-5	5,4	5,4
Deflection angle	µrad	36	36
Pulse current	Amp	6	6
Kicker voltage	Volt	200	200
Pulse power	Watt	900	900
Field length	mm	250	250
Zo of the kicker	Ω	50	50
Kicker subdivision		2	1
Free aperture	mm	40 x70	35 x 70

2.2 View from above into both kickers



2.3 Sectional view of the horizont. kicker

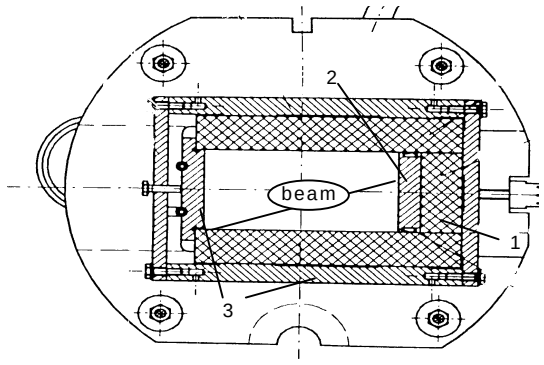


Figure 1.

.1 C yoke of the ferrite kicker
.2 Pulse conductor
.3 Ground conductor leading the Rf image current of the beam

2.4 Sectional view of the vert. kicker

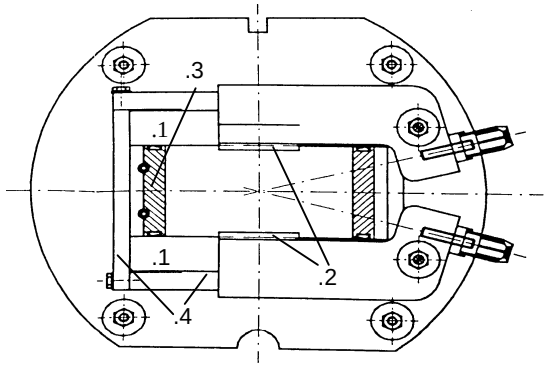


Figure 2.

.1 Ferrite plates, top and bottom
.2 2 Conductors near the ferrite
.3 Ground conductor leading through the kicker as chamber simulation
.4 Magnet holder

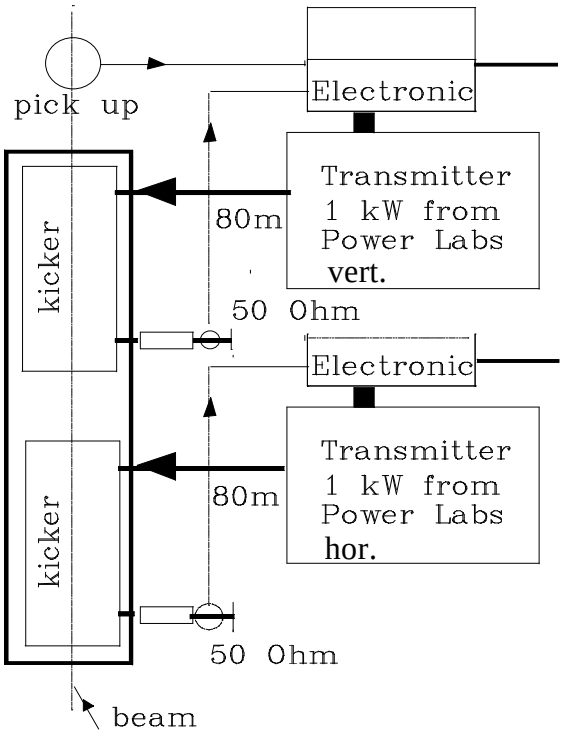
3. Both kickers and amplifiers

3.1 About reflections and phase shifts in cable and feedback kickers.

Different frequencies lead, in long cable to different phase shifts up to Π. The linear phase shift must be electronically compensated.

All the RC cells of the kicker must have Z = 50 Ohm and work without reflections and nonlinear phase shifts.

Only such kickers give linear and oscillation free short risetime of the field in the kickers.



3. Amplifier for the kicker drive.

The diagrams show amplitude- and phase shifts. The phase shift also the frequency correction is also shown.

3.1 Frequency responses of the amplifier

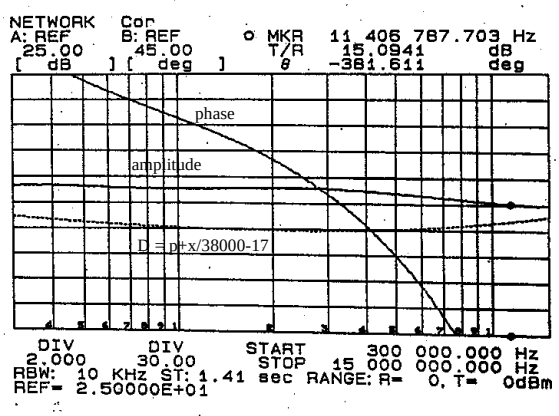


Figure 4.

3.2.Frequency responses of the horiz. kicker

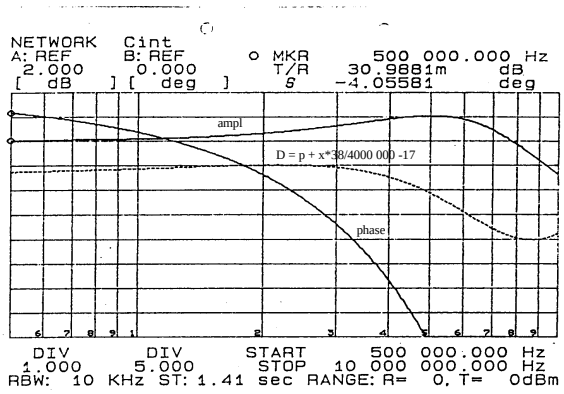


Figure 5

3.3. Amplifier and horiz.kicker (1kW)

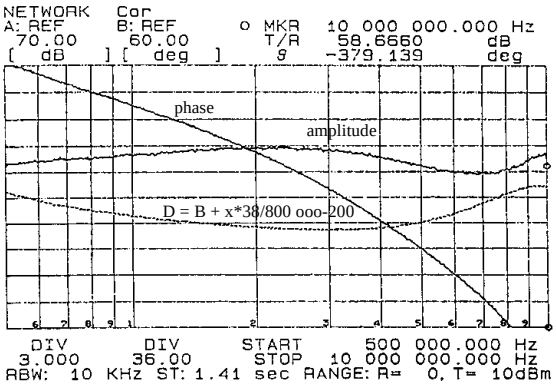


Figure 6

3.4. Frequency responses of the vert. kicker

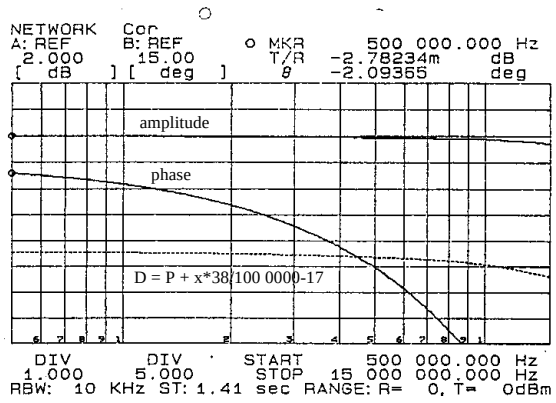


Figure 7

3.5. Amplifier and vert. kicker (1kW)

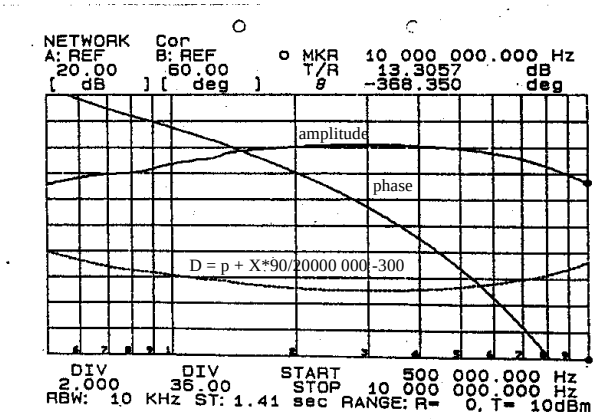


Figure 8

Results

First tests of the feedback system with positrons in PIA , show good results.

The kickers, the driving transmitters 1kW, the position monitor and the elektronics work well together.

The kickers damp the beam with the same time constant as the simulations show.

First measurements show further peak current with 3*10^10 particle in PIA. That is nearly 3 times mor than before.

References

(1)J.Rümmler,"Pilot Bunch and Long Pulse Ejection (t = 7.6 µs) with stripe Kickers out of PETRA for the Path to HERA." EPAC 90 NICE

(2) "Feedback Kickers in the DESY Rings" Jürgen Rümmler DESY / EPAC London

(3) Theory of Multi-Bunch Feedback Systems R.D. Kohaupt DESY 91-071

(4) Simulation for Transverse Feedback in PIA W.Kriens DESY November 1995