

PULSE CURRENT INTERLOCK FOR BESSY II STORAGE RING KICKERS

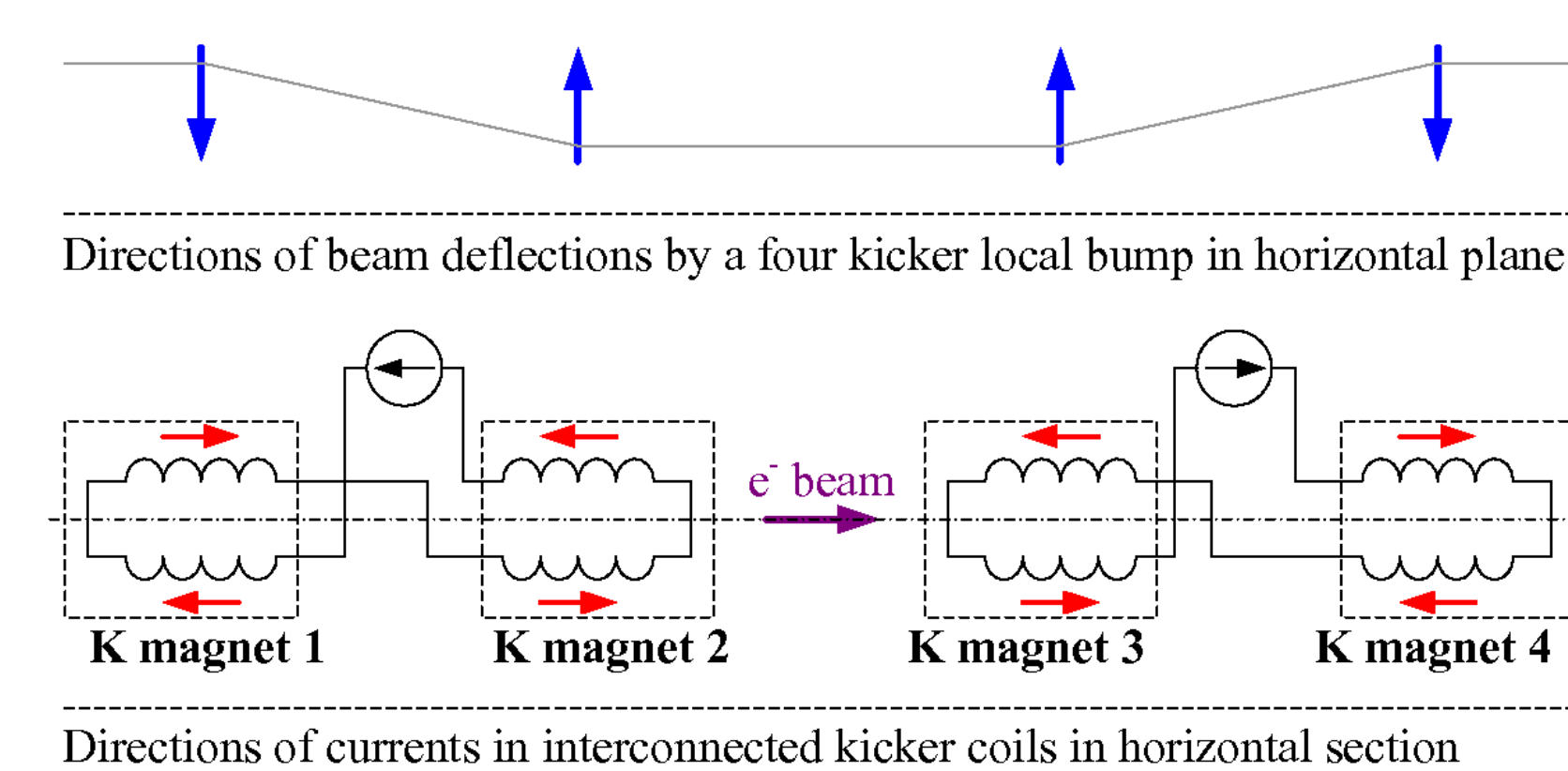
Technical Interlock Realization to Protect the Kicker Magnet Systems at BESSY II Storage Ring Injection

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ABSTRACT: The BESSY II storage ring injection consists of four single kicker magnets, which are energized in two pairs on each side of the septum magnet with one kicker pulser respectively. The kicker magnet cores consist of conductive Ultraperm foils. Therein are insulated coils with only one turn. The isolation of these coils from the core is heavily stressed during operation by the applied transient high voltage. A puncture of the insulation leads into serious damage of the kicker pulser technology, which is to be protected with this secondary interlock against the effects of an insulation failure of these kicker coils.

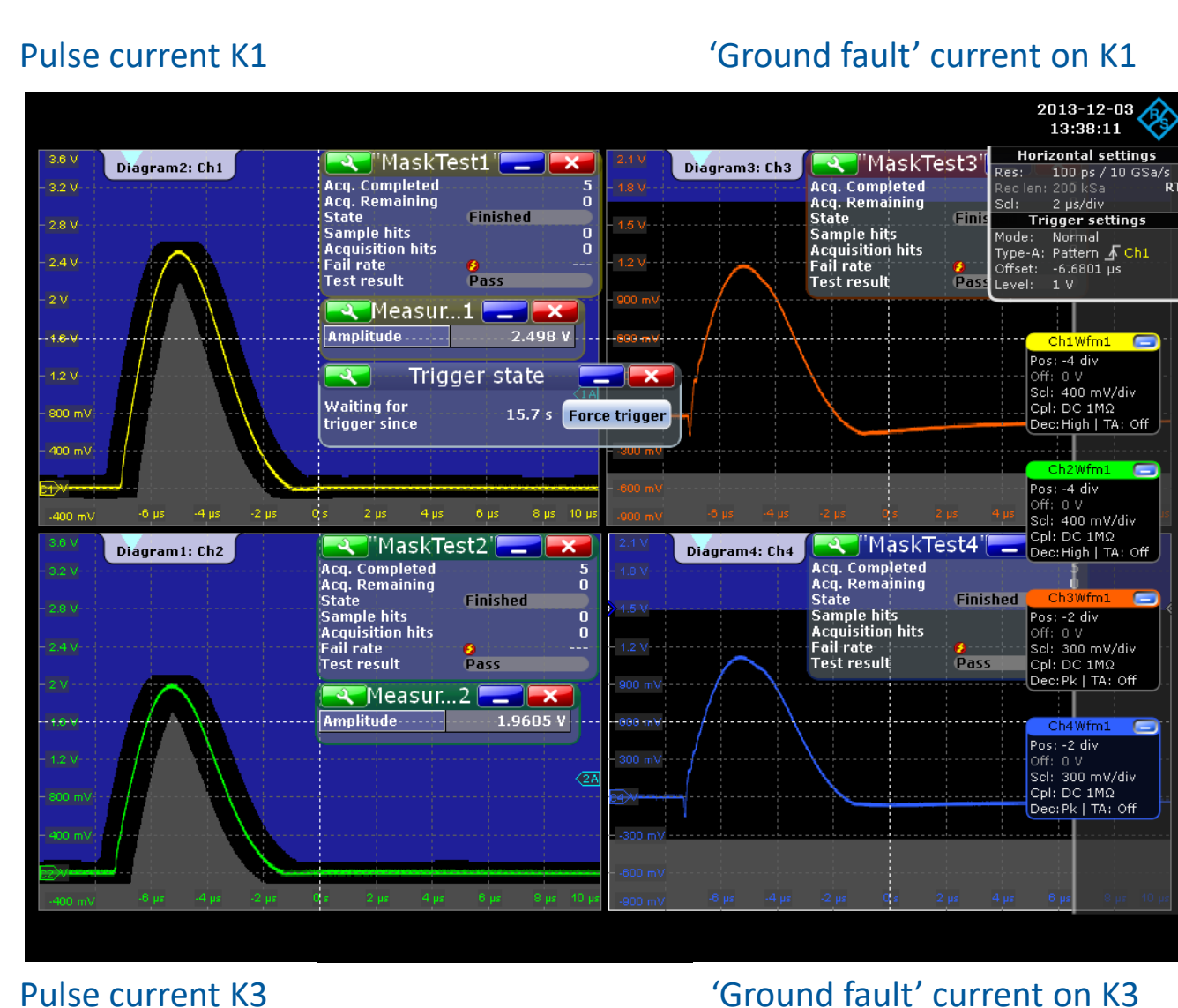
MOTIVATION

Protection of the kicker pulser hardware in the case of insulation failure of the magnet coil. The kicker current pulsers are lumped inductance circuits which are charged with voltages of up to 15 kV. The generated peak current \hat{I} is about 4.5 kA, accompanied with a transient HV originated by the charging voltage.

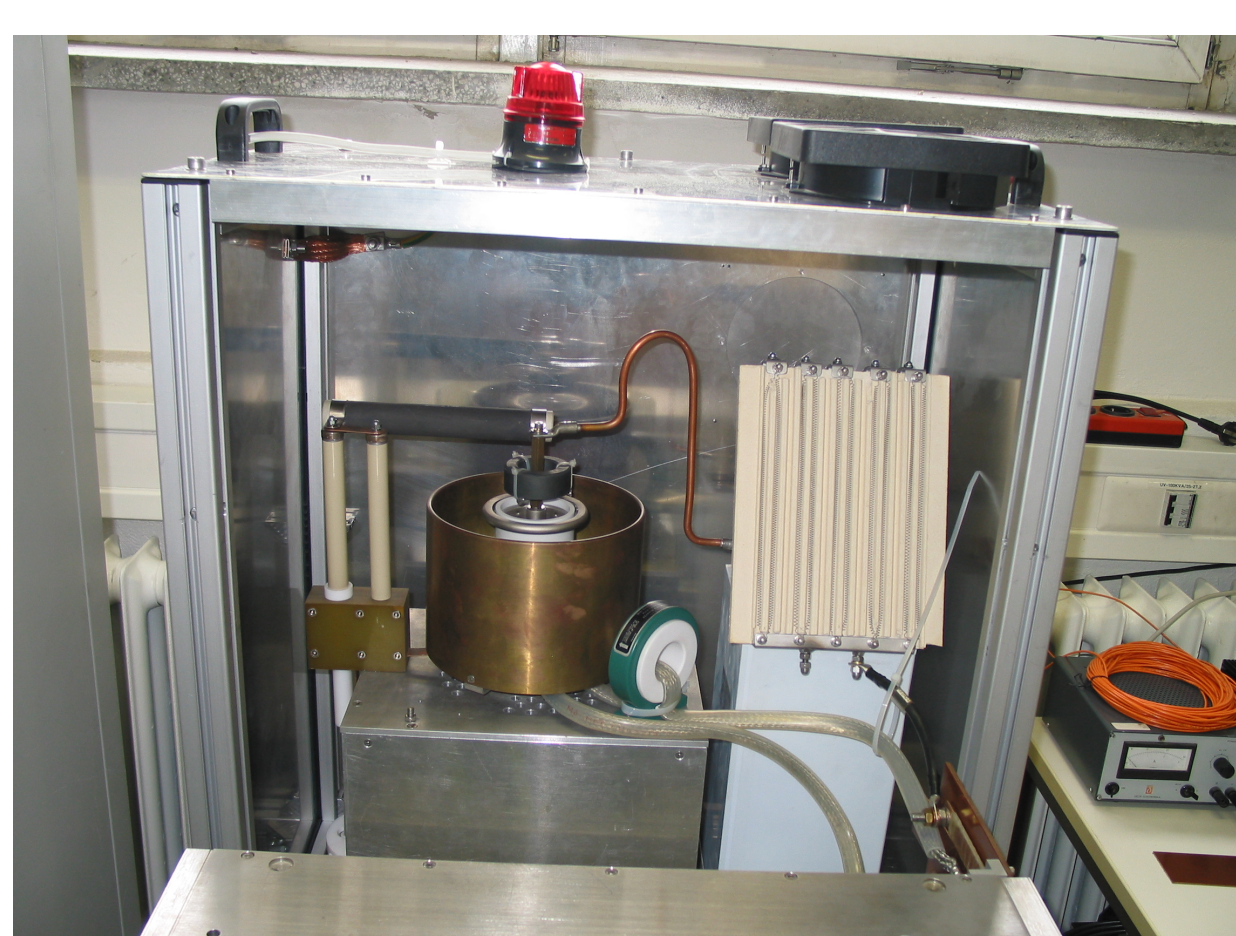


Measured Kicker Pulse Currents during Accelerator Operations

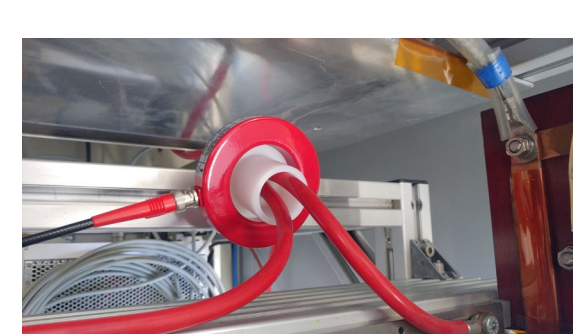
Healthy measurement



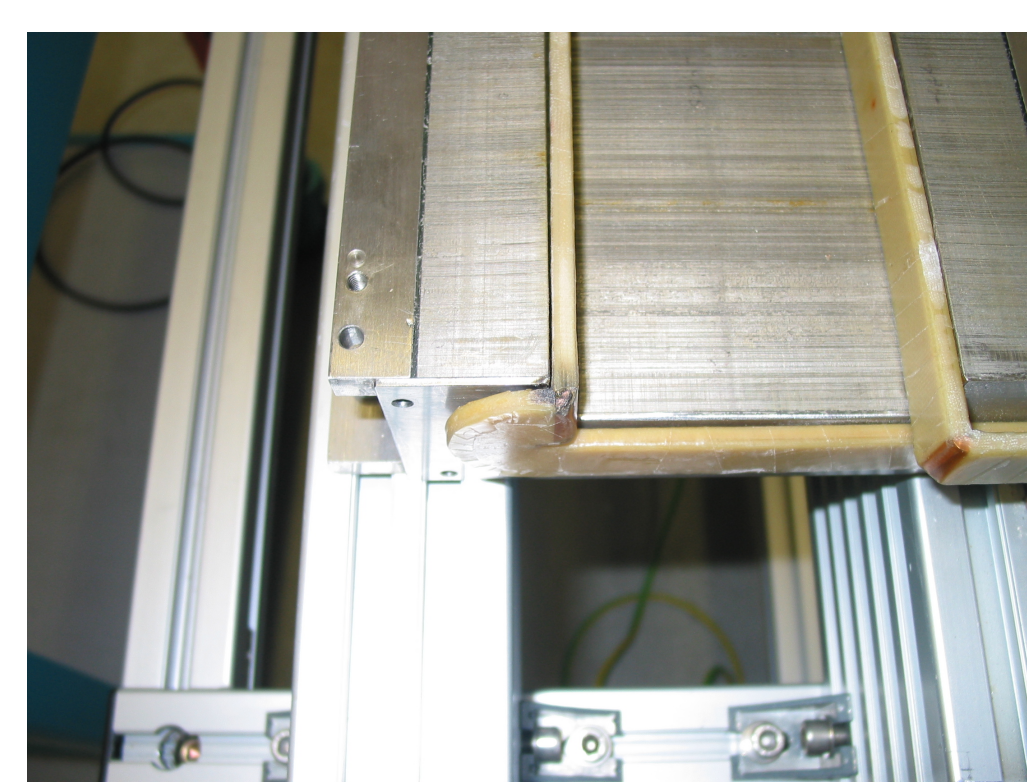
Open Kicker Pulser in Test Stand



Measurements in laboratory environment to validate the scope signals of pulse current and ground fault current.



Kicker Magnet Coil with Insulation Breakdown

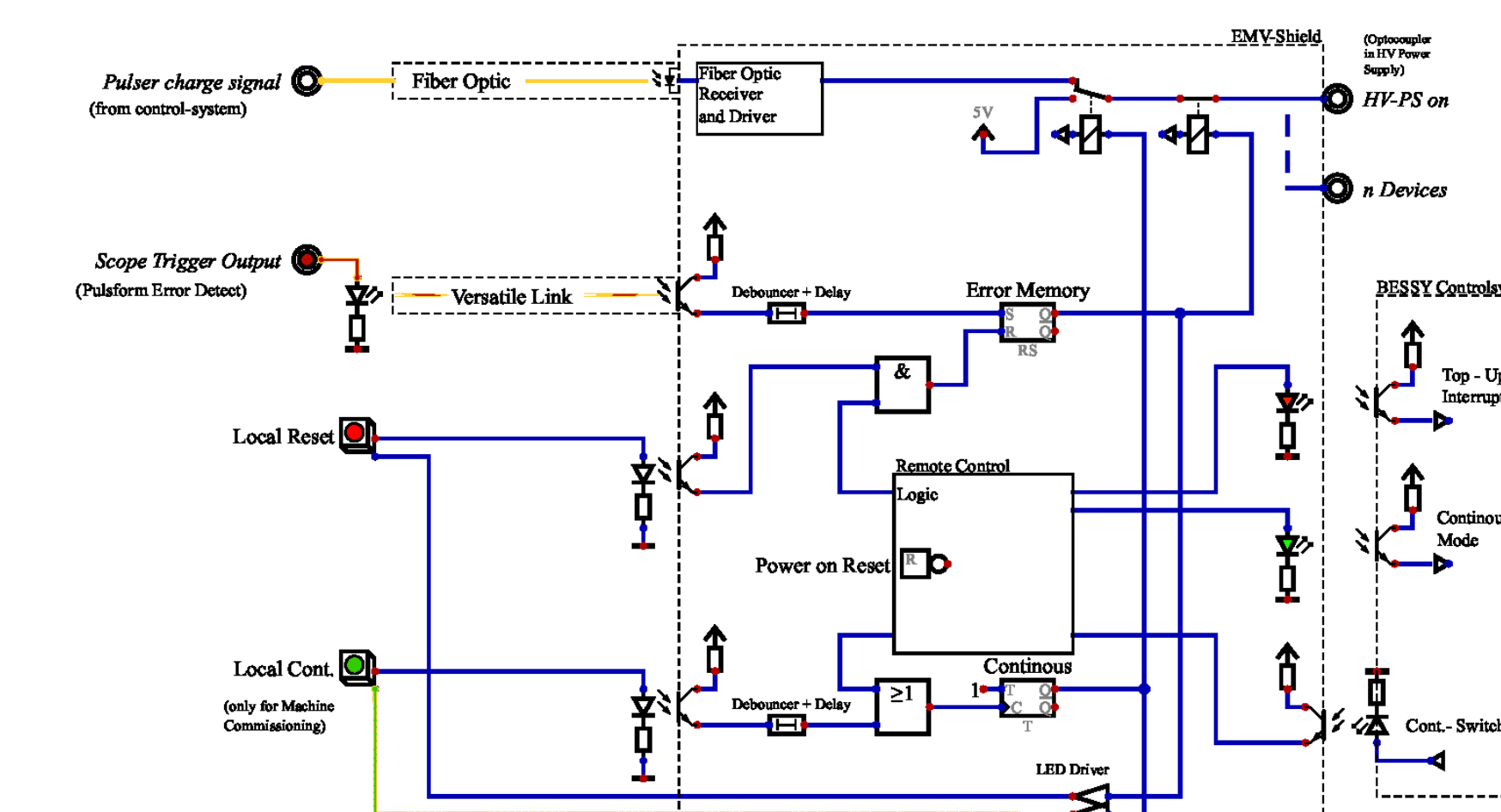


Spare BESSY II storage ring kicker magnet with faulty kicker coil in laboratory.

METHODS

Detecting breakdowns based on a pulse shape exceeding an oscilloscope mask. Independent pulsed current measurements with current transformers and evaluation using the internal R&S scope software. Turn off HV power supply to prevent further pulses following breakdown.

Interlock Circuit Schematics



RESULTS

The trigger evaluation electronics was developed to work as a secondary device interlock in conjunction with a R&S oscilloscope. As soon as it is powered on and activated by an external trigger output of the R&S oscilloscope, an interlock loop is opened on the HCK FuG Elektronik high voltage power supply, which prevents further supply of the charging voltage. If the interlock electronics is turned off, its functionality is not available but the operation of the pulser technology is still possible.

High voltage capacitor charging power supply
HCK 400 – 2000 MOD by FuG Elektronik



Applied R&S®RTO 1024 Digital Oscilloscope



CONCLUSION

By the use off an R&S RTO 1024 oscilloscope and with this hard wired circuit, it is possible without compromising on the kicker circuit system performance, and hence on the accelerator availability, to implement a kicker magnet interlock that prevents severe destruction of kicker pulser electronics.

1. J. Feikes, O. Dressler, 'Operational experiences with the BESSY II injection system', proceedings of the PAC99, p. 1279, New York, NY, U.S.A., 1999.
2. O. Dressler, J.-O. Kuszynski, 'Matching Pulse Shapes of the BESSY II Storage Ring Injection Kicker System / High Precision Pulse Measurements', PPC05, Monterey, CA, U.S.A., 2005.
3. O. Dressler, J.-O. Kuszynski, M. Markert, 'Modular Stand-alone Pulse Current Measurement System for Kicker and Septa at BESSY II and MLS', proceedings of the IPAC14, p. 3394, Dresden, Germany, 2014.

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