

RF LOW LEVEL ELECTRONICS FOR PROSCAN

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The RF system of the COMET Cyclotron is basically composed of the power amplifier and the low level RF electronics containing the amplitude regulation, the start electronics, phase and resonance measurements. The low level RF system (LLRF) is provided by PSI and is derived from the existing systems of the PSI cyclotrons. The same electronic system will also be used at the Rinecker Proton Therapy Center in Munich.

DESIGN OF THE LLRF

The superconducting cyclotron COMET uses a four dee acceleration system. Two of them are galvanically coupled in the central region and are therefore at the same RF-phase. The other two dees are capacitively coupled to the main dee and supposed to be in opposite phase (push-pull mode). One of the tasks of the low level RF is to detect this push-pull mode, or the wrong operating point in push-push mode.

All four RF dee voltages are added and stabilised by an amplitude feedback system. By switching to a locally set lower value, it will be possible to reduce the cavity voltage to stop the beam, and some time later switch back to the nominal accelerating voltage, all in a very short time.

But the first step is to find and lock on the resonance of the high-Q cavities. This is done by a phase detector, comparing the incident power and the cavity voltage delivered by a pick up in the driven dee.

Avoiding multipacting in the RF structure is possible by using the starting electronic unit with the feedback

regulation of the incident power. With only a few hundred mW of RF power, the proper resonance point will be located.

A very fast high pulse brings the cavity voltage to the operating level with no stop in between at multipacting regions.

The power amplifier is protected against excessive reflecting power with a detection system delivering an interlock to the safety box after about 1 ms. This unit will cancel the command "RF on" to the amplitude regulation.

The RF window will also be protected against discharge by means of shortly blanking of the RF power.

RESULTS

During the last days of 2004 the first power test with about 20 kW RF has been performed on the cyclotron. The entire electronic system, as far as it was possible to be tested, was working well. All the related documentation concerning was delivered to ACCEL to be applied to the medical cyclotron in Munich.

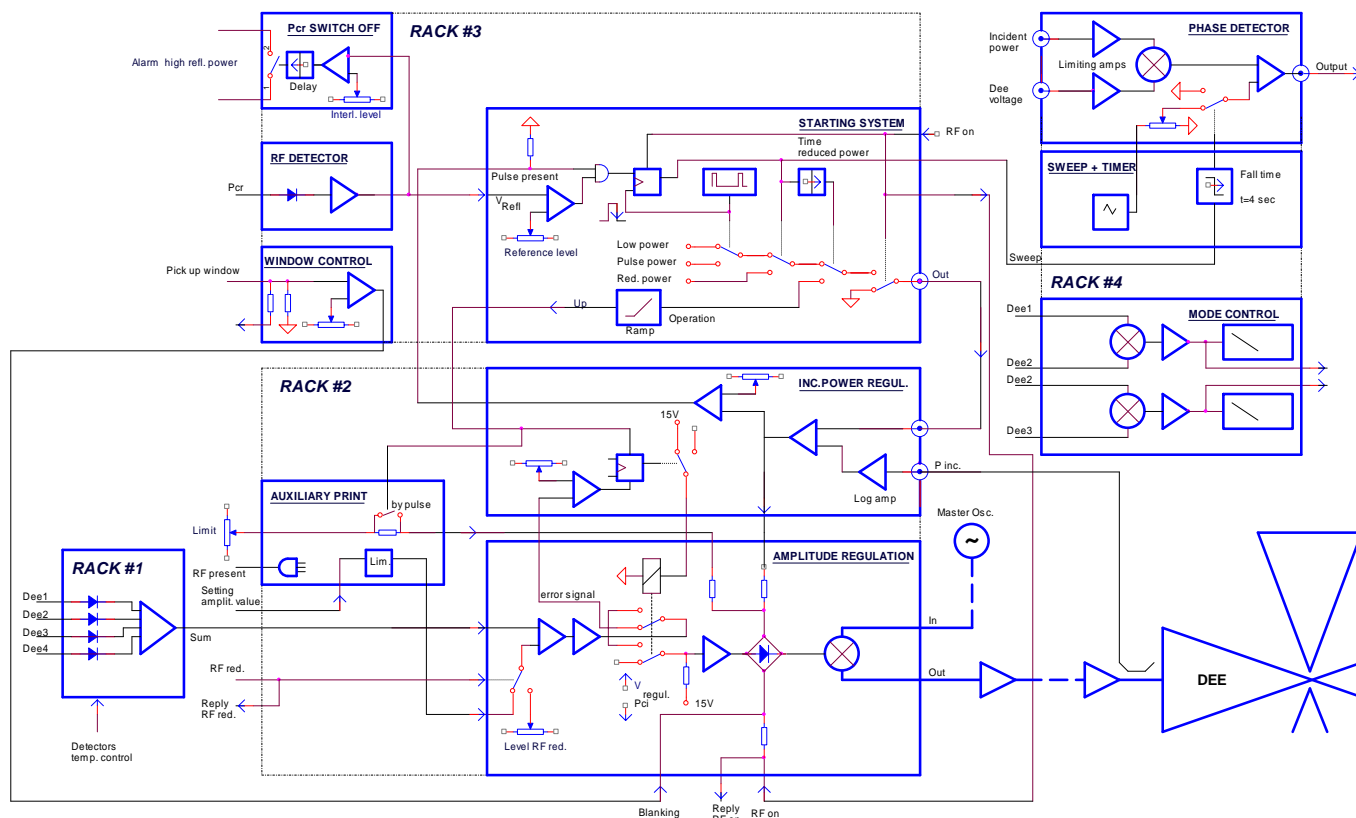


Fig. 1: Schematic of the low level electronic system for the COMET cyclotron.