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Distributed Low Voltage System for the FrontEnd electronics of the HADES RPC TOF wall

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This contribution presents the power supply system designed for the frontend electronics of the HADES RPC detector, installed at GSI (Darmstadt, Germany). The system is designed as a distributed architecture and contains custom Low Voltage boards based on DC-DC switching converters to obtain high efficiency and reduce spacing. The switching converters have been conveniently filtered to reduce EMI, obtaining very low output noise. Experimental results prove that the low noise levels achieved at the output of the switching converters behave as good as laboratory power supplies, not producing any worsening in the response of the frontend electronics.

Summary

The high sensitivity and bandwidth required by frontend electronics in physics experiments requires low noise supply voltages. Despite power supply systems being traditionally based on commercial linear power supplies, which provide very clean voltages, the increase of power demand with bigger and bigger experiments requires the development of more efficient and custom solutions.

The power supply system developed for the Resistive Plate Chamber detector (RPC) of HADES is based of self-made electronics making use of switching power techniques that provide the advantage of reaching high efficiencies at reduced space.

The power system consists of a distributed architecture: first, commercial AC-DC power supplies convert the 230AC mains into 48VDC. Then custom Low Voltage boards convert the 48VDC into the required low voltajes (+6V, -6V and +4V) via isolated DC-DC switching modules. Filters for the two principal modes of conducted EMI propagation (differential and common mode) were mandatory at the input and output of the DC-DC modules to reduce the output noise. Galvanic isolation of the modules avoids ground loops, which is a usual source of common mode EMI. The layout of the PCB was carefully considered to reduce parasitic capacitance to ground and mutual coupling (to reduce electrically and magnetically generated EMI respectively). A shielding box connected to input ground is used to limit radiated emission. Ripple at the output of the DC-DC board is lower than 2mV, and noise levels for a bandwidth of 1Ghz is as low as 25mV.

Twisted pair cables without any shielding carry the low voltages to the frontend electronics which contains Low DropOut regulators (LDO) to provide stable voltages at the point of load and compensate for the different voltage drops due to various cable lengths.

The control system is based on the 1-wire bus, that is used to provide monitoring of output currents and voltajes, being the 1-wire bus controlled by an ETRAX single chip computer that sends the data through Ethernet via EPICs.

In summary The power supply system designed for the HADES RPC frontend electronics features high efficiency by using switching DC-DC converters. To avoid interferences with the frontend electronics, the supply voltage is filtered to provide very low noise levels, taking special care of the common mode noise. Experimental results for a full sector reveal the possibility of using such a power system without worsening the response of the frontend electronics, obtaining a time resolution for the frontend electronic of 50 ps.

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