We explore the feasibility of powering the HEP detectors with 48 Volts DC and using local 48 V to 1.3 V (depending upon the layout of the high front-end electronics) local regulators located very close to the silicon chips. These devices are exposed to nuclear radiation and high magnetic fields. The numbers for the LHC are 10 – 100 Mega rats and 2 – 4 Tesla, while for ILC, they are 20 K and 8 T.

**Background**

We have been involved with the ATLAS and CMS detector construction at CERN. Ylikoht ’designed and manufactured the low voltage regulator cards for the ECAL of CMS (see fig. CMS). The total numbers of cards is about 3.1K, each delivering 16 amps at 2.5 Volts to the front-end 0.35 micron CMOS chips. The total load is 75 Kamps. The power supplies are located 30 meters away on the magnet pole and supply 8.3 volts, with a loss of 1 Volt in each leg of the power cable. The regulator card input is 4.3 V. The voltage across the regulators (LHC4913 made by S.T. Microelectronics) is 7.8 volts for the minimum dropout voltage needed after 10 years of exposure to the radiation. These are linear voltage regulators in which all the input power is dissipated to the resistor package which is cooled to the cold finger of the ASIC. Linear regulators have low power efficiency but have low output noise and low EM. Figure 1 is a layout of the DC power system to make the point of the efficiency of delivering the power to the detector (in this case, only 40%).

After constructing the CMS ECAL, power delivery system, we have been exploring alternative methods of delivering the power to the front end chips. For the ILC, the SiD detector will require 50 Kamps while the CalliCUE detector will need 300 Kamps. The feature size of the front end silicon chip regenerating to 65 nano meters, operating at even lower voltages and higher currents. It is not clear yet if the power consumption of the system will decrease with the feature size. To address these issues, we are exploring the use of air core transformers to reduce the voltages to be handled by the ASIC and the FETs. These are some of the issues that need to be explored.

**40 Ampere Converters on each stave.** Here the PCB traces carry increasing more current towards the end.

A switched-mode power supply (SMPS), is an electronic power supply unit (PSU) that incorporates a switching regulator, an internal feedback circuit, a pulse-width modulator, and usually a voltage or current sensor for feedback purposes. A typical SMPS, uses a power switch (called a transistor or a MOSFET) to control a high-voltage, high-current power source. The SMPS is used in many areas where high efficiency, compactness, and low cost are required. The switch is turned on and off at a high rate, called the switching frequency. The SMPS is also used in many areas where high efficiency, compactness, and low cost are required. The switch is turned on and off at a high rate, called the switching frequency. The SMPS is also used in many areas where high efficiency, compactness, and low cost are required. The switch is turned on and off at a high rate, called the switching frequency.

Our objective here is to focus on high supply voltage (48 V) with outputs in the range of 2 – 30 amps. This work is limited to using only air core coils.

**Switch Mode: Synchronous Rectification.**

A switched-mode power supply (SMPS), is an electronic power supply unit (PSU) that incorporates a switching regulator, an internal control circuit that switches the load current rapidly on and off in order to reduce the output voltage. Switching regulators are used for the large power supplies where higher efficiency is required and where higher power densities are needed. They are more complex and more expensive, and their switching regulators can cause current problems if not carefully suppressed.

Power converters are used in the power electronics industry. Product manufacturers and suppliers of electrical equipment are demanding ever-increasing performance (i.e., higher efficiencies, lower output voltages, higher currents, faster transient responses) from their power supplies.

To meet these demands, switching power supply designers in the late 1990s began adopting Synchronous Rectification (SR), the use of MOSFETs to achieve the rectification function previously performed by diodes. SR improves efficiency, thermal performance, power density, manufacturability, and reliability, and decreases the overall system cost of power supplies.

In DC-DC Converters, the average DC output voltage must be controlled to be equal a desired level though the input voltage and output voltages or higher currents. For higher voltages Class-Ⅱ RF amplifiers convert DC to RF at very high efficiencies. Ref (Sokal).

Other schemes: there are many variations based on the above to optimize zero voltage, zero current switching and topologies for high efficiencies. Our objective here is to focus on high supply voltage (48 V) with outputs in the range of 2 – 30 amps. This work is limited to using only air core coils.

**Switch Mode: Synchronous Rectification.**

An output voltage (48 V) with outputs in the range of 2 – 30 amps. This work is limited to using only air core coils.

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