x. RHIC Bipolar Corrector Power Supplies

The bipolar 50A corrector power supplies operate on the principles based on the simplified block diagram shown in Fig. 2-20.

The incoming 3 phase 208 VAC, after going through 3-phase rectification and simple LC filtering, is fed into a dc-dc converter. The output of the converter is controlled by a tracking voltage loop, which constantly monitors the difference between the converter output filter voltage and the magnet voltage and make it equal to a voltage set point. What this means is that the converter will track the magnet voltage to keep the voltage drop across the MOSFET output stage constant. 4 MOSFET transistors switching at 100 kHz make up the converter. The four quadrant converter has an H bridge configuration. Output voltage is controlled by pulse width modulation (PWM) technique.

The MOSFET output stage of the power supply consists of 8 transistors and also has an H bridge configuration. Each of the upper MOSFET operates linearly. That is, it regulates the current by acting like a variable resistor. In contrast, each of the lower MOSFET acts like a switch.

There are basically three types of feedback loops employed in the power supplies: an inner voltage feedback loop, an overall current feedback loop, and a tracking voltage loop. With a resistive load, the current feedback has a frequency response of 4 Hz. Putting the power supply into voltage mode disables the current feedback. In this case, the power supply turns into a voltage regulator and has a frequency response of 1 kHz.

The tracking loop minimizes the output stage power dissipation by keeping the voltage drop across the MOSFET transistors to about a volt. Whenever the tracking loop fails to track the output voltage the power dissipation increases, which can lead possibly to a thermal shutdown. Feedback is taken after the dc-dc converter output filter. The frequency response of the tracking loop is about 3 Hz.

Both voltage and current compensation can be accomplished on an external compensation board, which is mounted onto the power supply control board via an opening in the front panel.

Although the power supplies employ dc-dc converters, they have to meet the following noise specifications: For normal mode ripple, Vr < 5mVpp narrow band (20 Hz– 1 kHz) and < 50 mVpp wide band (1 kHz – 1 MHz). For common mode ripple, Vr < 20 mVpp narrow band and < 200 mV wide band.

All of the corrector power supplies provide four analog signals SETPOINT, DCCT, OUTPUT VOLTAGE, and ERROR at the front panel for troubleshooting and testing purposes. The first three signals are also available at the rear panel. In LOCAL mode, the set point for the 50A unit can be adjusted on the front panel by turning a knob.

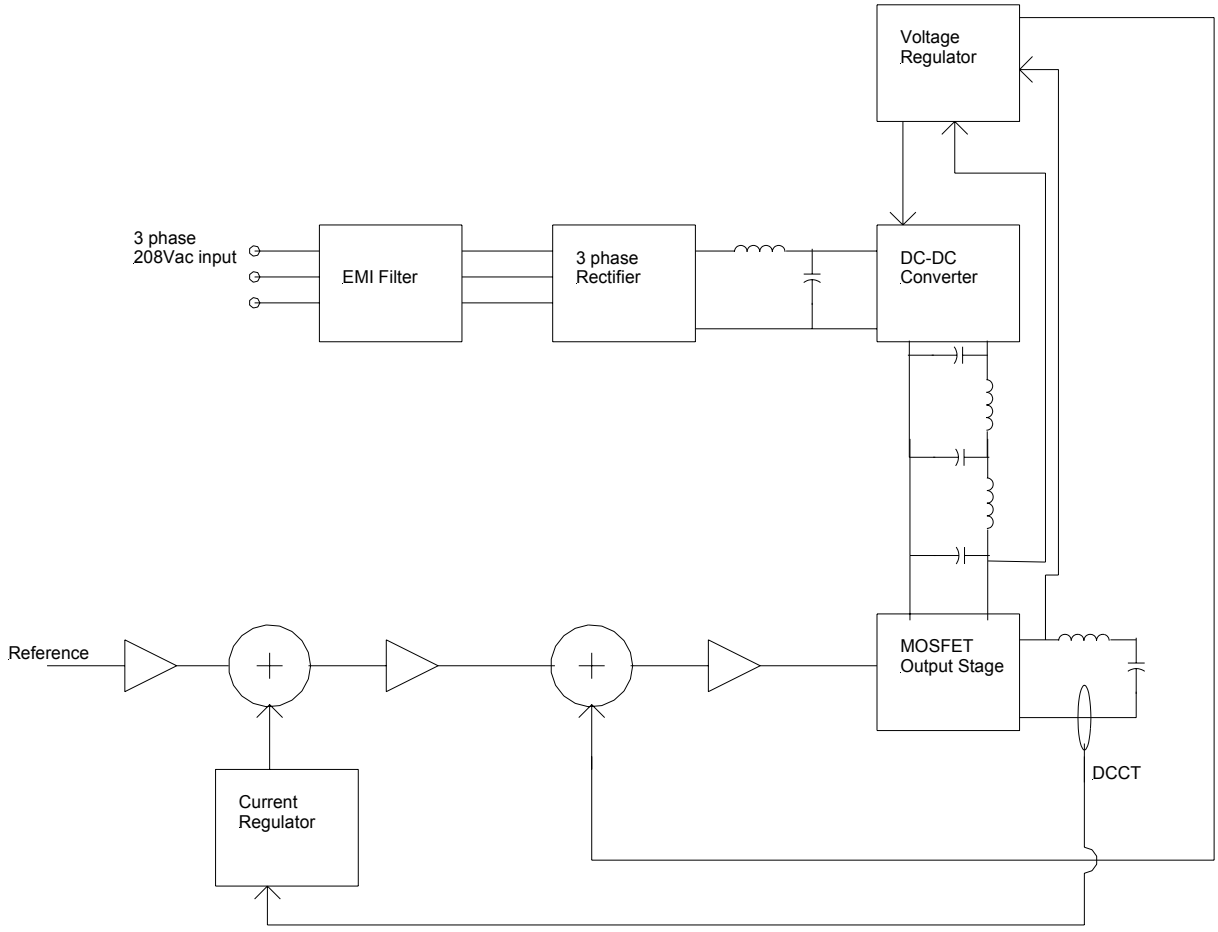

Fig. 2-20 RHIC Bipolar Power Supply Simplified Block Diagram