CEBAF PR-90-017
September 1990

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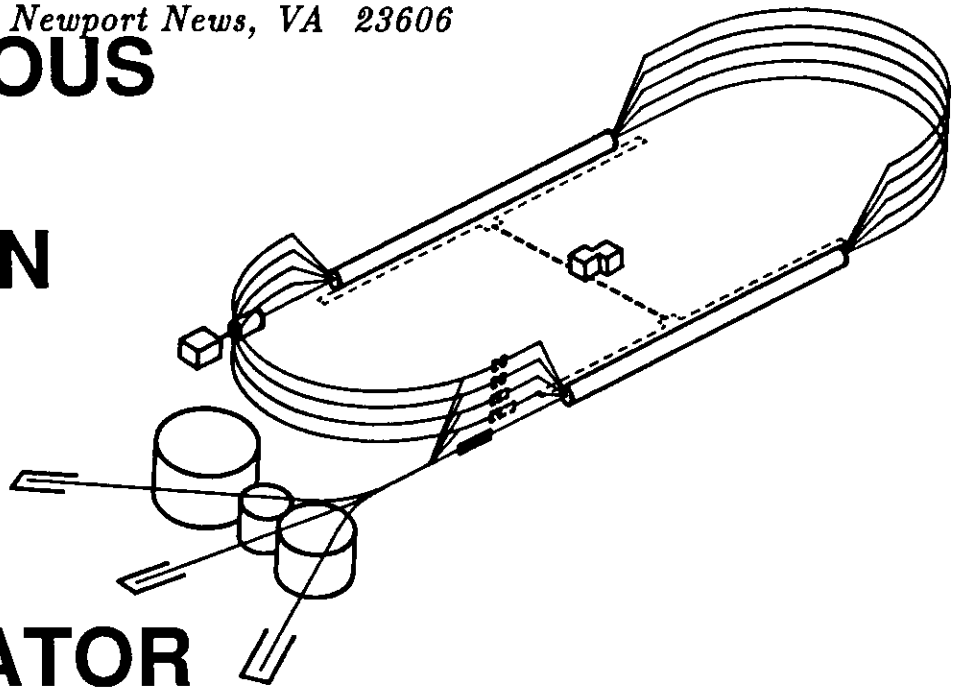

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Newport News, Virginia

PRECISION, 32 CHANNEL POWER SUPPLY SYSTEM*

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Abstract

A modular, multichannel current regulator system has been developed to power the low current correction and focusing magnets used for beam transport. The basic module consists of a relay rack housing four card crates with eight regulators per crate. The rack also contains a utility chassis and common power supplies. Each regulator card includes a communications microprocessor and a temperature controlled analog circuit block containing precision reference, serial DAC, shunt resistor and error amplifier. The regulators are linear, bipolar units capable of furnishing up to 10 amps at 20 volts with less than 0.01% ripple and drift.

Introduction

The block diagram of a typical system is shown in Figure 1. Although all 32 channels are shown in the diagram, initially some of the regulator slots in the rack will be left open for future additions due to more magnets or higher power requirements.

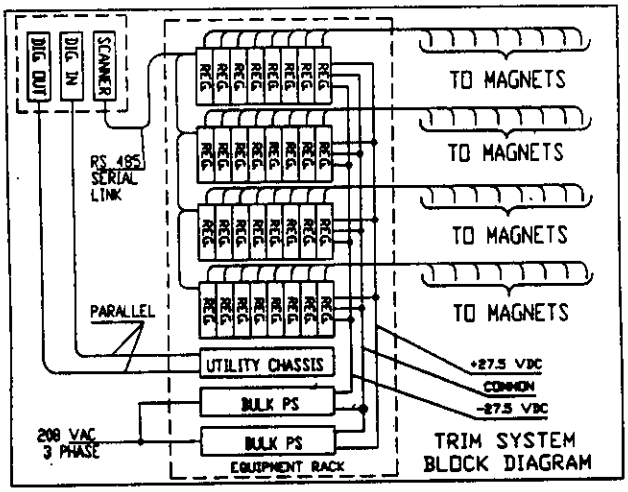

Figure 1. Trim System Block Diagram.

Although only the corrector dipoles require a bipolar output, all of the regulators have this capability. This allows all of the current regulation needs to be handled by one design. Having only one regulator design kept the initial development effort down, made the configuration of the systems very versatile, made a more economical buy possible and will make maintenance easier.

Because of the relatively tight packaging requirements, a large blower was added on top of the rack. The blower pulls filtered, ambient air through louvres in the back door and up through four levels of regulator modules. A drawing of the mechanical rack is shown in Figure 2.

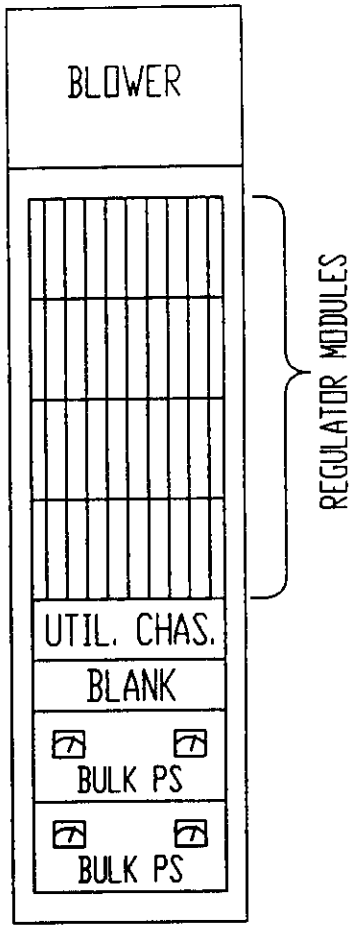

Figure 2. Mechanical Rack Drawing.

* This work is supported by U.S. Department of Energy under contract DE-AC05-84-ER40150.

Monitor and Control

Because of the relatively stringent 100 ppm output noise and drift specification, the monitor and control of the regulator is handled entirely by a full duplex serial communications link. This greatly reduces the chance of coupling ground loop or other noise into the input stages of the regulator.

An on-board communications microprocessor drives the 16 bit serial DAC located on the analog block, monitors the 16 bit current readback ADC, monitors a 12 bit, 4 channel, general purpose ADC and handles digital I/O functions on the printed circuit board. Both of the ADC's are slow, dual slope integrating devices.

The serial link is designed to achieve a scan cycle time of 50 milliseconds or less with 32 nodes on the network. Because the microprocessor is used for communications only 1/32 of the available time, there is considerable time open to do on-board diagnostics and control. Possible examples are controlled ramping of the output current and monitoring of the output voltage allowing calculation of the magnet coil resistance.

The microprocessor is an 8 bit Motorola device with 4K of on-chip ROM. About 2K of the ROM is used for the basic communications and control tasks, leaving 2K for further diagnostics and control. The code was written in assembly language.

The 32 node, RS-485 serial link is driven by a 32 channel scanner module. The scanner is a commercially available, double wide CAMAC module that functions entirely as a communications controller. The communications microprocessor interfaces with the CAMAC system through dual ported memory.

Performance

These current regulators were able to meet a 24 hour, 100 ppm noise and drift specification over an ambient temperature swing of 40°C during tests in an environmental chamber. The temperature coefficient over the 40°C swing was 1 ppm per degree C. The 100 ppm specification includes power line ripple as well as low frequency noise. It is unlikely that any of the service buildings will see a 40°C temperature swing over any 24 hour period after warm up, so the installed systems should be able to match the performance shown in the regulator board tests.

Summary

A straightforward and versatile power supply system has been designed to drive the low power corrector and focusing magnets in the accelerator beam transport system. A simple bipolar regulator module furnishes 10 amps at 20 volts. Common bulk power supplies furnish pre-regulated power for the regulator cards. Current low frequency noise, drift and ripple are within a 100 ppm envelope. Monitor and control of the regulator modules is handled with an RS-485 compatible serial link driven by a 32 channel CAMAC scanner module.