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1- OVERVIEW

During normal system operation, temperature variations can occur in the environment and within the magnet of system. These temperature inconsistencies result in an inconsistent magnetic field B_0, leading to an unstable image. This phenomenon can be corrected by applying an additional shimming technique in the form of Z2.

2- EFFECTS OF TEMPERATURE VARIATION

Temperature inconsistencies occur during the operation of OpenSpeed due to the heating of the RF and Gradient Coils. Temperature control devices are implemented within other parts of the system (heaters, water flow, air flow) to actively control the temperatures, but some variation occurs within the iron rings which cannot be controlled actively. This temperature variation in the iron rings of the system causes the magnetic field B_0 to become inhomogeneous. The unstable magnetic field results in an inconsistent center resonant frequency, which ultimately leads to a poorer image. This effect must be resolved.

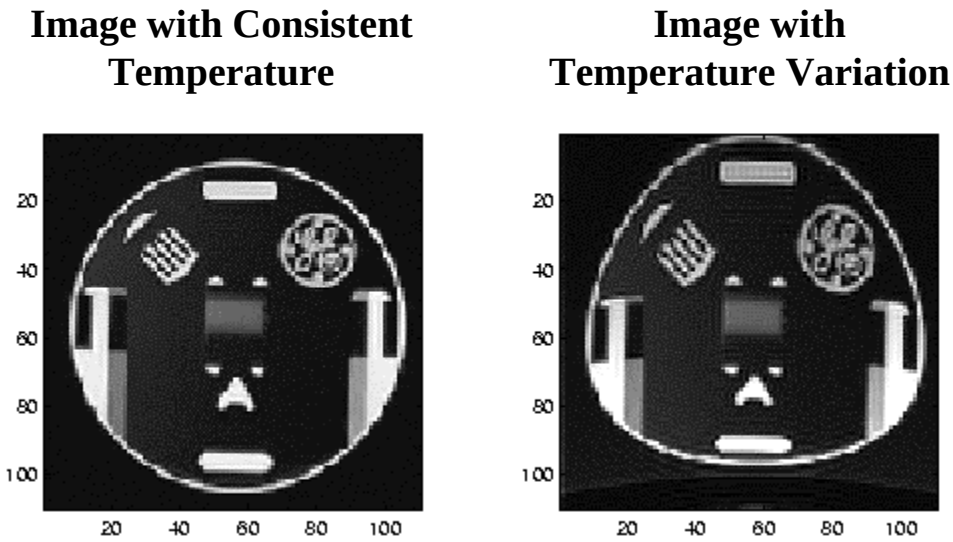


IMAGE DISTORTION EXAMPLE
ILLUSTRATION 2-1

2-1 Z2 Compensation Method

The change in homogeneity of the magnetic field in the system can be measured, and this phenomenon behaves with second order Z2 characteristics. Thus compensation in the form of additional second order Z2 shimming can be applied to the system to effectively correct the inhomogeneous magnetic field.

3- Z2 COMPENSATION SYSTEM COMPONENTS

The system that compensates for temperature variation consists of four major components: the Z2 Resistive Shim Coils, the eight Temperature Sensors, a Temperature Controller (Fluke model 2620A Hydra Series Data Acquisition Meter), and the Z2 Power Supply.

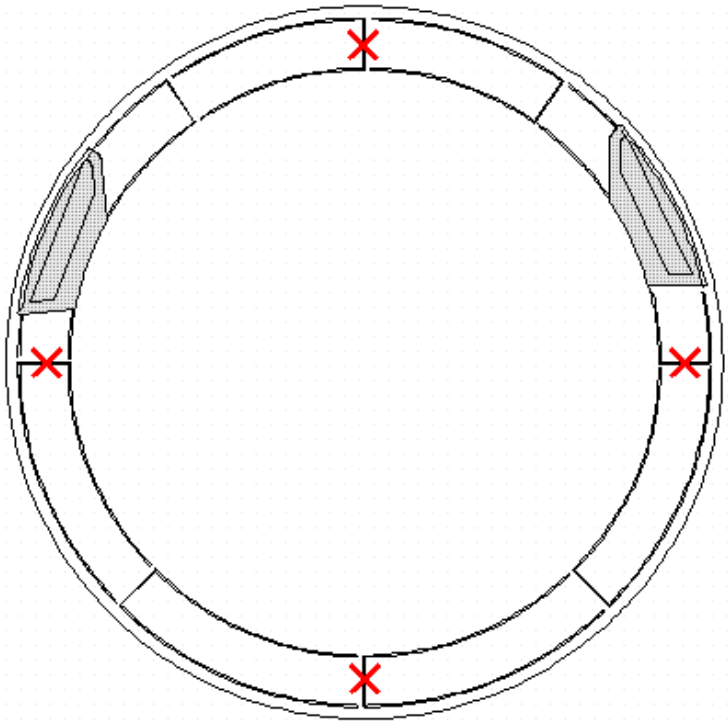
3-1 Z2 Resistive Shim Coils

The Z2 Resistive Shim Coils for the device are located within the main gradient coils of the magnet and are used specifically for Z2 correction of temperature inconsistencies.

3-2 Temperature Sensors

4 temperature sensors are located on the iron ring for each of the top and bottom halves of the magnet and are used to measure the actual temperatures at those positions.

3-2-1 Location of Temperature Sensors



TEMPERATURE SENSOR LOCATIONS
ILLUSTRATION 3-1

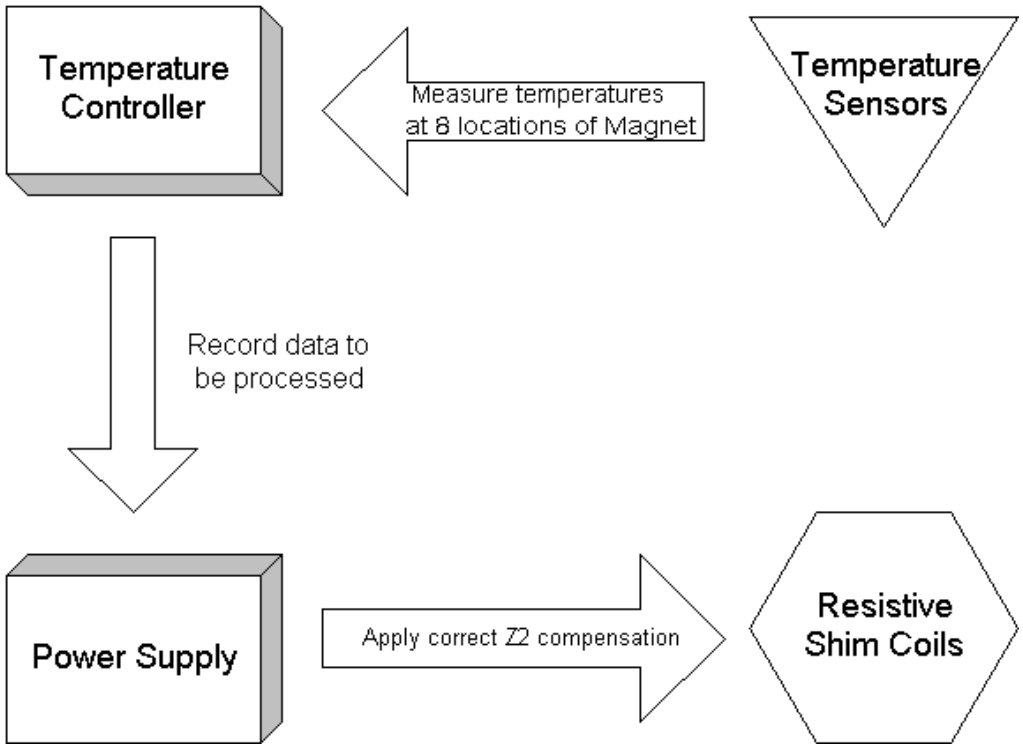
3-3 Temperature Controller

The temperature controller (Fluke Model 2620A) is located within the Systems Cabinet and acts as the interface between the sensors and Shim Power Supply. The temperature controller collects temperature readings from the sensors and sends them to the Power Supply for processing.

3-4 Z2 Power Supply

The Z2 Power Supply is located within the Systems Cabinet and supplies the shimming current for the Z2 Shim Coils. The Z2 Power Supply continuously polls the Temperature Controller for updated temperature readings. It then averages the readings and applies the correct compensation algorithm to the Z2 Shim Coils.

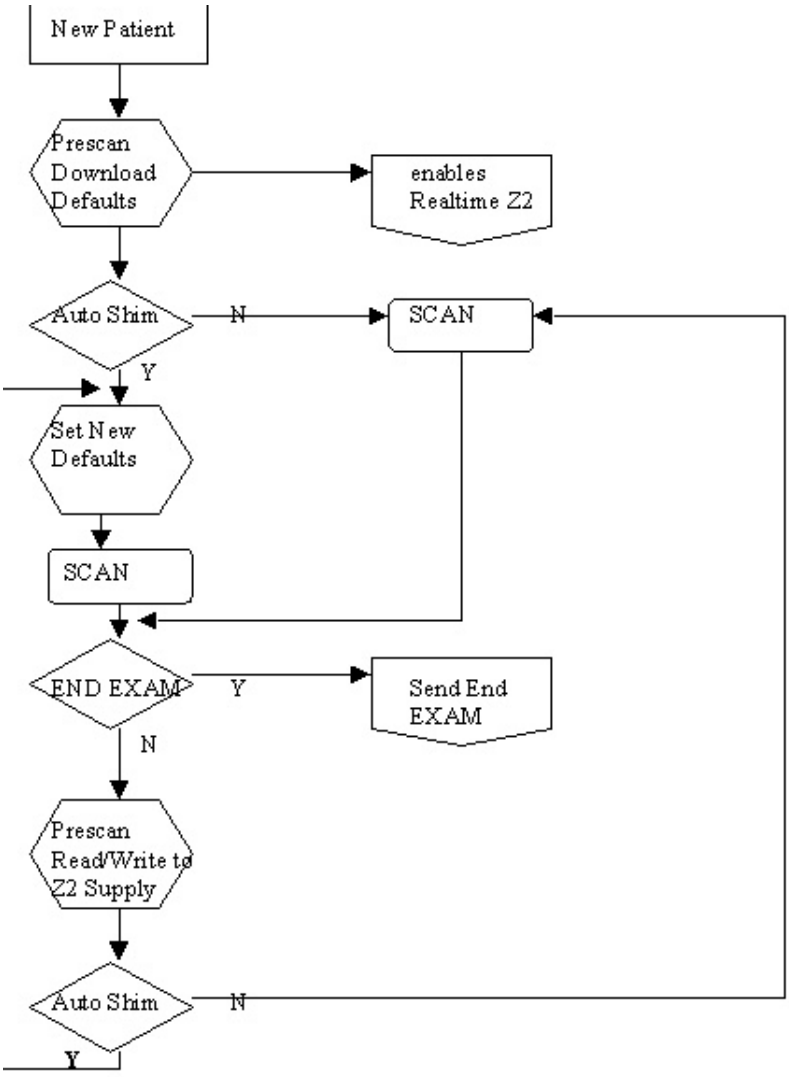
4- FUNCTIONING SEQUENCE



BLOCK DIAGRAM
ILLUSTRATION 4-1

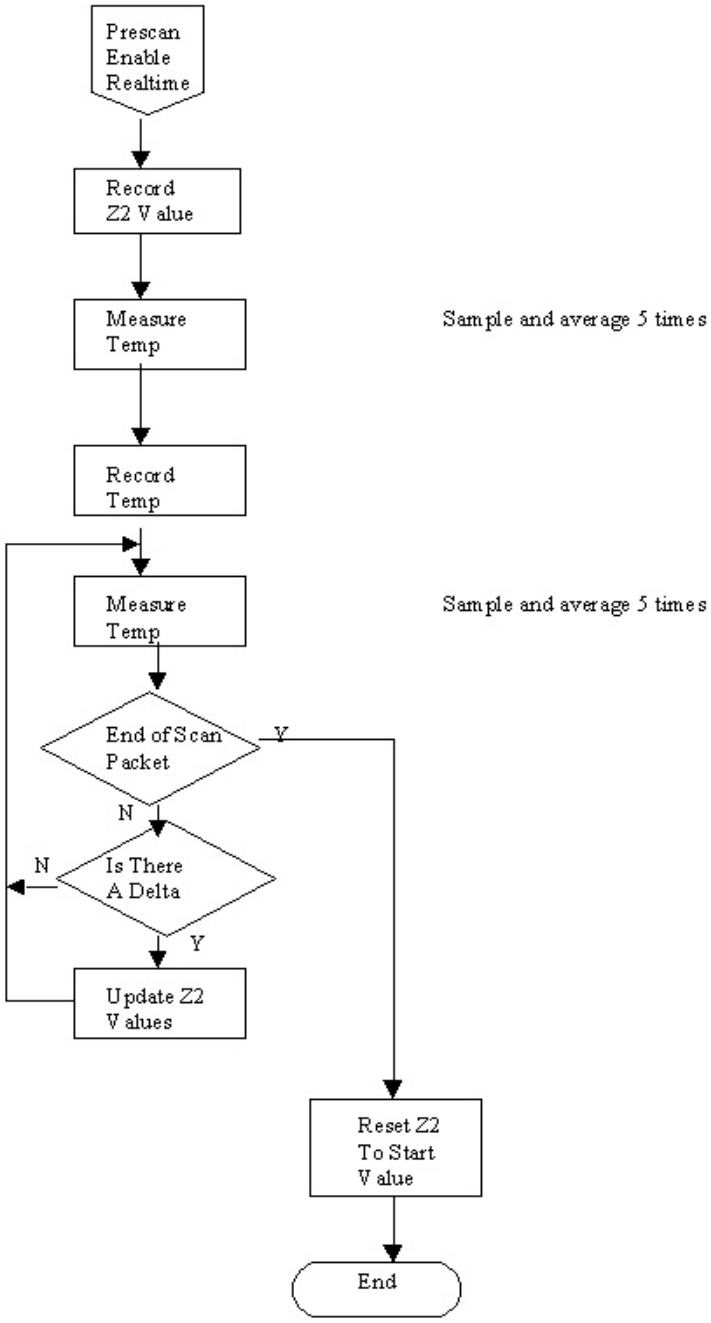
Prior to each scan series, the host performs an Auto Shim procedure to measure the temperatures and calculate the new required Z2 resistive shim offset. The host then communicates to the Z2 Power Supply to set this level on the Z2 channel. During a scan series, the iron rings of the OpenSpeed system may heat or cool. The Temperature Controller continuously provides the Z2 Power Supply with temperature readings. The Power Supply processes these readings and generates a new Z2 resistive shim offset. The new Z2 resistive shim offset is placed in a latch and transferred to the Z2 Output Amplifier on the falling edge of the TTL high Data_In_Window. (This is done to prevent shim changes from asynchronously occurring during a scan).

4-1 Scanning Sequence Flow Chart



Z2 COMPENSATION SCANNING LOOP
ILLUSTRATION 4-1

4-2 Real Time Sequence Flow Chart



Z2 COMPENSATION REAL TIME LOOP
ILLUSTRATION 4-2

REVISION HISTORY

REV	DATE	AUTHOR	PRIMARY REASONS FOR CHANGE
A	June 29, 2000	R. Liu	Initial Release