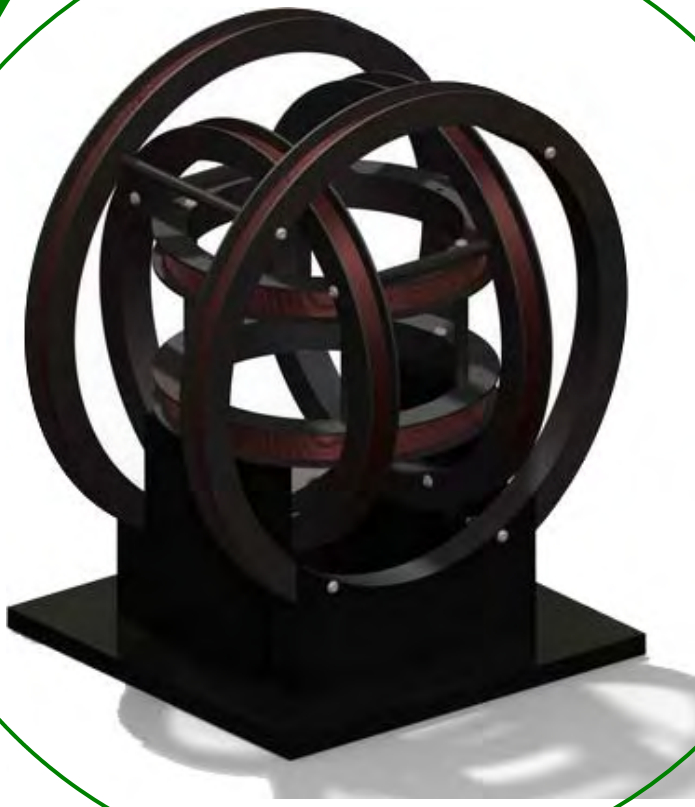
SpinCoil Series

Helmholtz Coils and Controllers



Micro Magnetics

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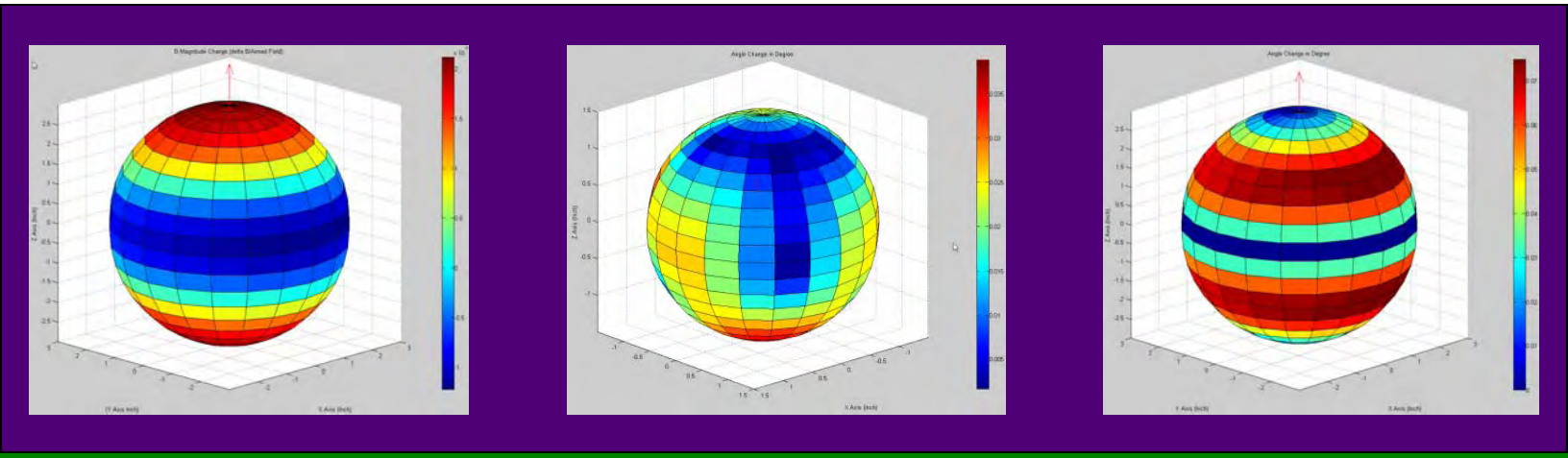

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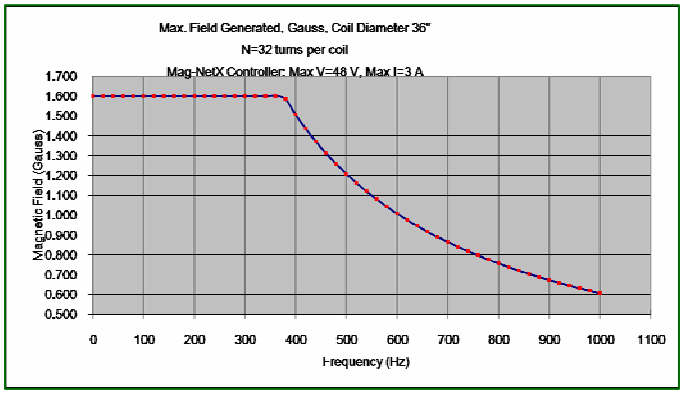
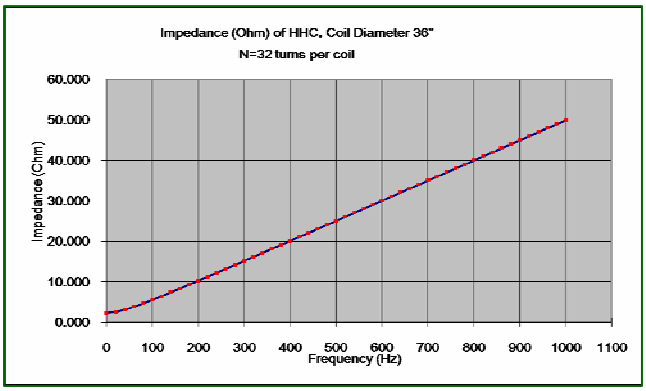
Applications of Helmholtz Coils and Controllers

The SpinCoil Series Helmholtz Coils and Controllers are used to generate uniform magnetic field over certain volume in space. Each set of Helmholtz coils consists of two coils in a special arrangement to maximize the spatial volume of uniform magnetic field. The magnetic field generated is propositional to a DC or AC current into the coil. We offer one, two and three-axis systems that can be used in a wide range of applications, including:

- Calibration of magnetic sensors.
- Measurement of magnetoresistance of magnetic or spintronic devices.
- Measurement of Hall effect of magnetic or spintronic devices.
- Measurement of magnetic properties of materials (e.g., magnetic susceptibility).
- Generation of magnetic field in a moderate to large spatial volume.
- Generation of static or dynamic (e.g., rotating) magnetic field vectors.
- Educational demonstration of magnetic field generation.
- Observation of interaction between magnetic field and magnets.
- Generation of zero field environment by canceling the earth's magnetic field.
- Confinement of plasma inside an evacuated container (e.g., a glass bulb).
- Use for nuclear magnetic resonance experiment.



Max. field generated by a custom-made 30" Coil w. 30 turns of coils.



Impedance of a custom-made 30" coil w. 30 turns of coils.

Features

- Quality construction: SpinCoil series Helmholtz coils use high quality insulating materials for the physical frame. The conducting wires are encapsulated in epoxy for mechanical stability. The physical package and the windings of the wires are manufactured for maximum field uniformity and stability.

- Accurate calibration: We design the Helmholtz coils' physical and electrical parameters based on the theory of electromagnetism. On top of this, we provide an accurate experimental calibration data for each set of Helmholtz coils.

- Adaptive platform design: We provide a set of mounting holes for the sample holder platform in the uniform field region. Customer can also purchase sample holder platform which guarantees central alignment for measuring sample.

- Easy operation: colored banana connectors on the stand of the Helmholtz coils are used to connect to the external power supply, with each color indicating the polarity of current direction, and hence, the field direction.

- Multi-axis magnetic field generation: the SpinCoil series are designed such that single, double, or triple sets of Helmholtz coils can be easily assembled together. As a result, you can generate magnetic field vectors in X, XY, or XYZ coordinates.

- Customer centered services: We guarantee our products against defective parts and poor workmanship. We also offer customization services based on each customer's requirements. Please contact us for your needs.

1-axis Helmholtz Coils

2-axis Helmholtz Coils

3-axis Helmholtz Coils

Theory of Operation of Helmholtz Coils

The Helmholtz Coils use two identical coils of conductive wire to produce a three dimensional region containing a uniform magnetic field. It achieves such a goal by positioning the coils so that certain field components cancel each other out while other components reinforce each other.

The main parts of the Helmholtz Coils are the two coils of wire. Since the coils are identical in every way, (wire material, wire gauge, resistance, radius R), feeding the same current to both coils will create two identical magnetic fields. The key characteristic of the Helmholtz Coils is how the two coils are placed. Each coil lies along the same axis, and the separation between the coils is equal to each coil's radius.

When current passes through the coils, the ensuing magnetic fields then interact in important ways in the space between the two coils. Applying the Right Hand Rule, one sees that the fields perpendicular to the common axis run into each other and cancel each other out. The same rule also shows that the fields parallel to the common axis run in the same direction, reinforcing each other. All the canceling and reinforcing leaves a uniform field in a cylindrical volume between the two coils. Specifically, the volume has a radius (r) equal to 25% of coil radius (R) and a length equal to 50% of the distance between the two coils.

Applying the Biot-Savart Law and simplifying the relation between input current and magnetic field strength in the uniform region becomes:

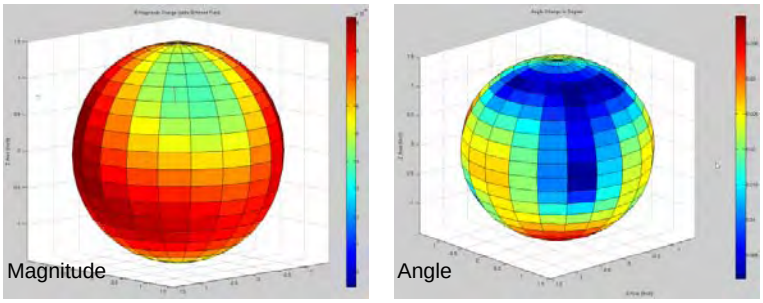
$B = (0.8991\times10^{-6}\ nI)/R$, *Where:*

B = field in Tesla;

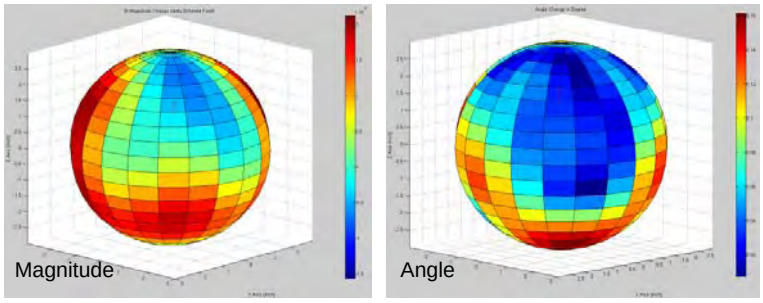
n = number of turns in a coil;

I = current in amperes;

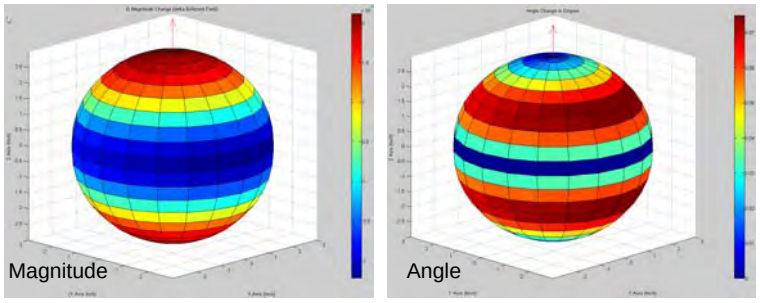
R = coil radius in meters.



B_0=(1,1,1) Oe at origin, sphere dia 3", max Δmag=0.1%, max Δangle=0.04



B_0 =(1,1,1) Oe at origin, sphere dia 6", max Δmag=0.2%, max Δangle=0.16



B0=(0,0,1) Oe at origin, sphere dia 6", max Δmag=0.2%, max Δangle=0.08

Magnetic uniformity map of a 3-axis Helmholtz Coil system made by Micro Magnetics in Fall River, Massachusetts.