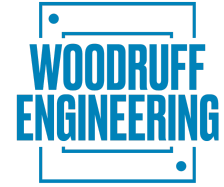


## Two-Axis Helmholtz Coil Systems

Orthogonal Dual-Axis Vector Magnet Systems · Water-Cooled High-Field Operation · Nested Coil Pairs  
100mm–1000mm · Vector Fields up to 300mT

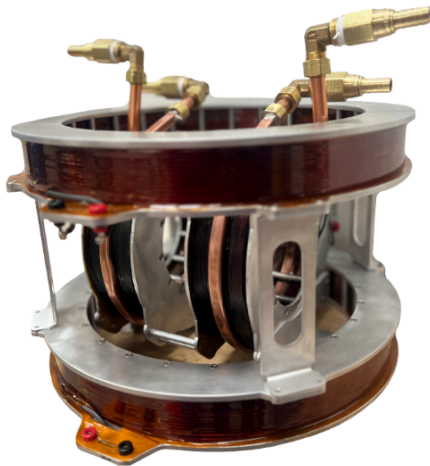
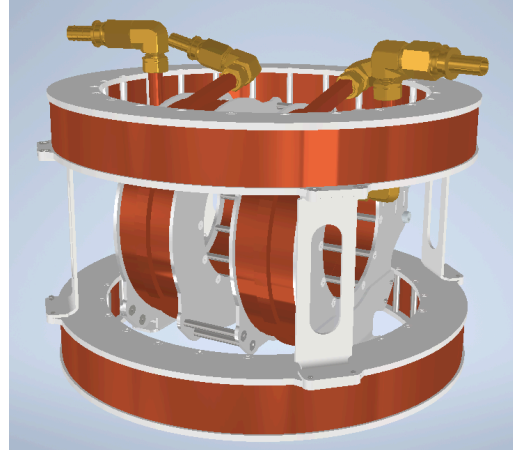


**VECTOR FIELD CONTROL** · Orthogonal geometry · Independent axis control · Rotating field synthesis · Precision 2D field mapping

Doc Ref: WE-HC-TWO-AXIS-001 · Rev 01 · 2026-03-16

### Planar Vector Magnetic Field Control

Woodruff Engineering's Two-Axis Helmholtz Coil Systems provide complete vector magnetic field control within a plane using two mutually orthogonal nested coil pairs, enabling arbitrary field direction and magnitude from 20mT to 500mT per axis for vector magnetometry, planar magnetic field mapping, anisotropic materials characterization, and directional sensor calibration requiring two-dimensional field synthesis. Built as dual-nested Helmholtz configurations with X and Y axes perpendicular, these systems generate combined in-plane vector fields up to 707mT ( $500\text{mT} \times \sqrt{2}$ ) with full  $360^\circ$  angular coverage in the horizontal or vertical plane, serving research laboratories, calibration facilities, and production testing environments.



### Dual-Nested Geometry and Thermal Management

The dual-nested geometry ranges from compact benchtop systems with innermost coils of 150mm diameter to large metrology-grade installations with outermost coils exceeding 1200mm, providing working volumes from 50mm to 300mm diameter circular regions with  $<1\%$  departure from peak field along both axes simultaneously. Standard air-cooled configurations support intermittent operation and moderate field strengths suitable for sensor testing and calibration applications, while water-cooled variants feature hollow copper conductors with integrated cooling channels enabling continuous operation at 200mT per axis and pulsed operation with appropriate duty cycles for high-field materials research and advanced magnetometer characterization.

### Dual-Channel Power Supply and Vector Control

Woodruff Engineering supplies matched dual-channel power supplies with independent current control for each axis, featuring  $\pm 0.2\%$  regulation, closed-loop feedback, and synchronized output capability for rotating field generation and dynamic vector field synthesis. Control interfaces support both Cartesian coordinates ( $B_x$ ,  $B_y$ ) for independent axis programming and polar coordinates ( $B$ ,  $\theta$ ) for intuitive in-plane vector magnitude and angle specification. AC-capable power supply options support frequencies up to 500Hz on both channels with phase-locked operation, enabling rotating magnetic fields for AC susceptibility measurements.

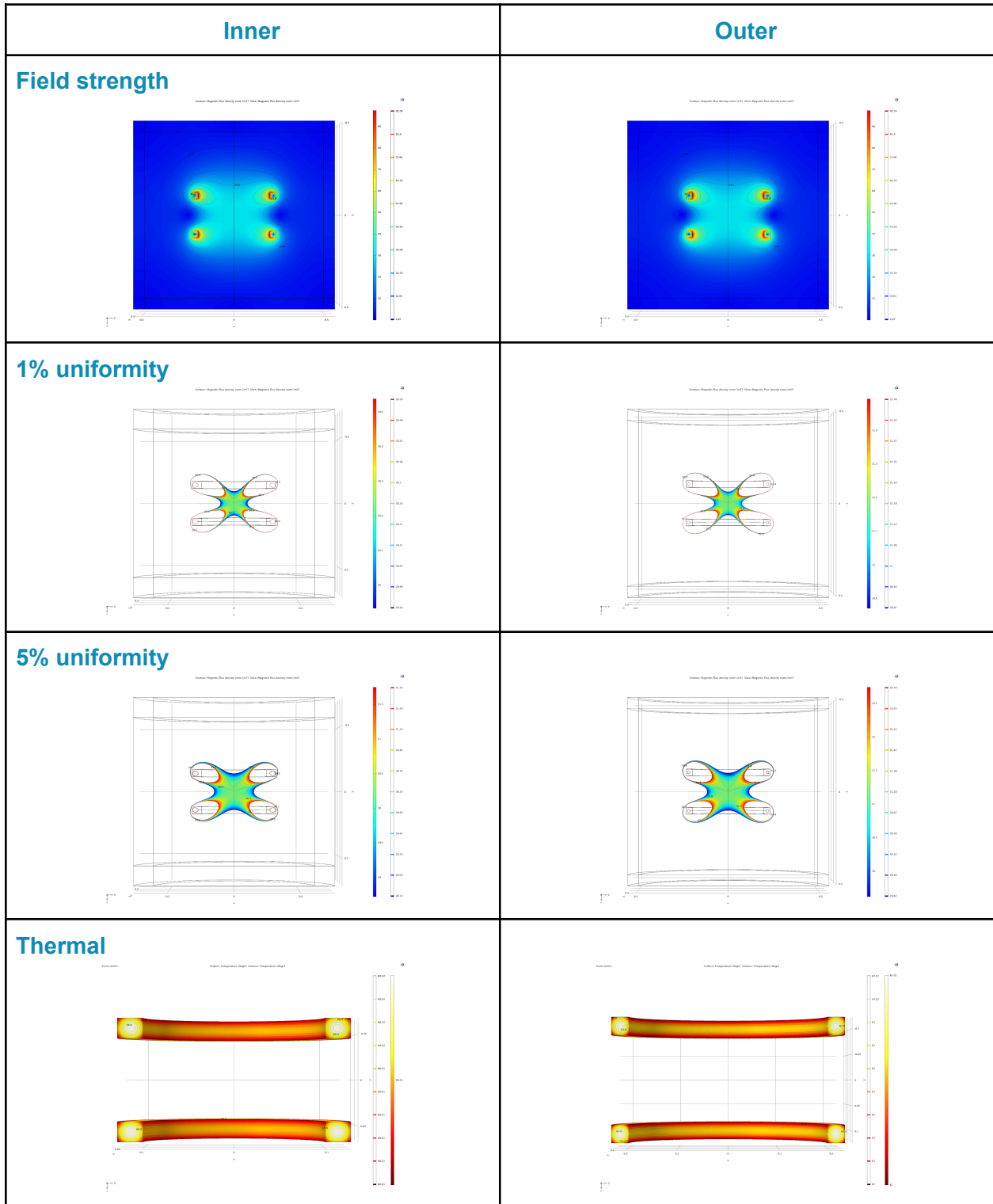
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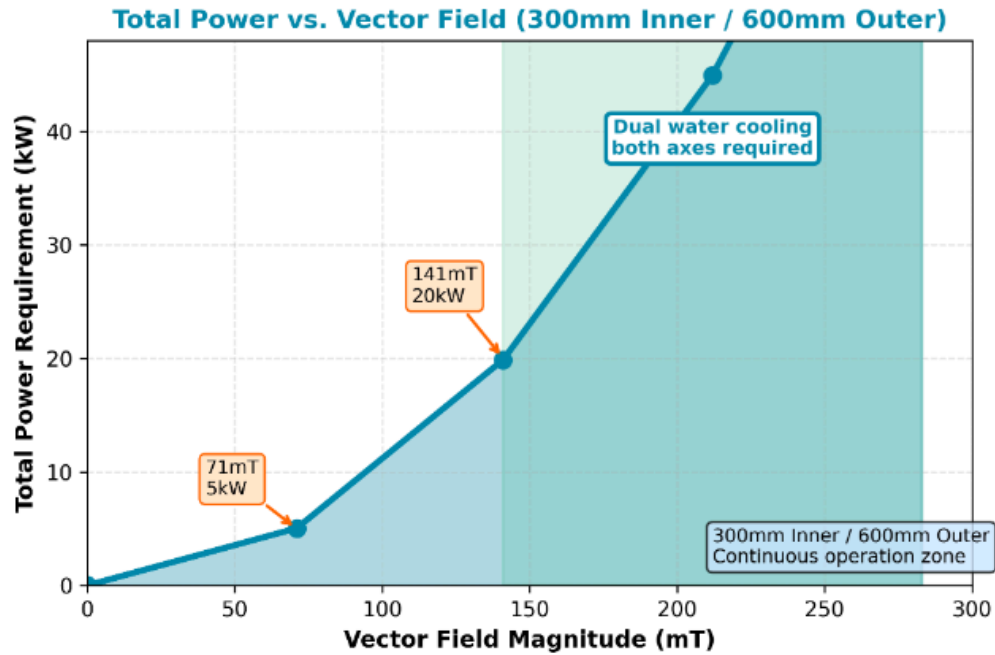
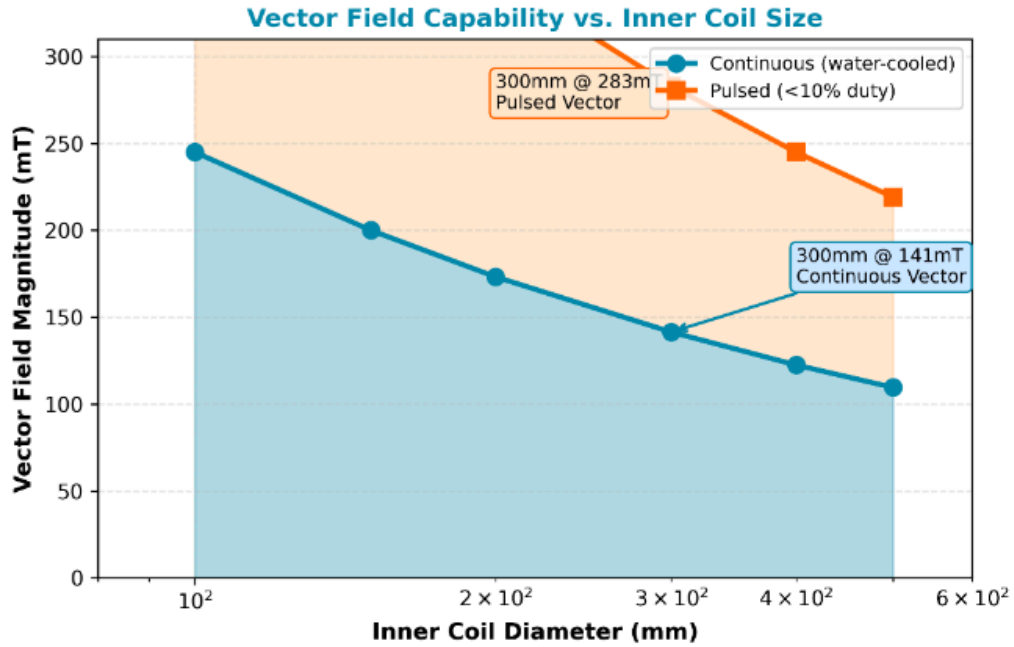
Production datasheet – specifications based on WE-OR-000035  
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## Example COMSOL simulations for a nested 2 axis HH coil set



## Example Parameter Space Plots for a nested 2 axis HH coil set



## SYSTEM SPECIFICATIONS

<b>Field Strength Per Axis</b>	30–200 mT (300–2000 G) <i>Continuous: 30–100mT; Pulsed: up to 200mT per axis</i>
<b>Vector Field Magnitude</b>	Up to 300 mT ( $200\text{mT} \times \sqrt{2}$ ) <i>Maximum when both axes at 200mT</i>
<b>Inner Coil Diameter Range</b>	100mm to 500mm <i>Defines working volume access</i>
<b>Outer Coil Diameter Range</b>	200mm to 1000mm <i>Typically 2× inner diameter</i>
<b>Field Uniformity</b>	<1% over central 50% of inner coil <i>Both axes independently &lt;1% uniform</i>
<b>Angular Resolution</b>	Limited by PSU precision <i>Typically &lt;0.1° with digital control</i>

## THERMAL MANAGEMENT

<b>Cooling Method</b>	Water-cooled both axes <i>Independent cooling circuits per axis</i>
<b>Total Coolant Flow Rate</b>	2–20 L/min (size dependent) <i>Split between two coil pairs</i>
<b>Inlet Pressure</b>	20–40 PSI (1.4–2.8 bar) <i>Standard facility water compatible</i>
<b>Continuous Operation</b>	100mT per axis, 141mT vector <i>Both axes full field simultaneously</i>
<b>Pulsed Operation</b>	200mT per axis, 283mT vector <i>10% duty cycle, brief pulses</i>
<b>Thermal Cross-Talk</b>	Minimized by independent cooling <i>Each axis thermally isolated</i>

## ELECTRICAL CHARACTERISTICS

<b>Total Power Requirements</b>	2–40 kW (diameter/field dependent) <i>Sum of both axes, 2× single-axis</i>
<b>Power Supplies</b>	Two independent regulated DC PSU <i>Synchronized control for vector synthesis</i>
<b>Operating Voltage</b>	Typically 24–120 VDC per axis <i>Varies with coil resistance</i>
<b>Operating Current</b>	10–500 A per axis <i>Design dependent, higher for compact coils</i>
<b>Field Stability</b>	<10 ppm/hour per axis

	<i>Requires precision dual PSU</i>
<b>Control Interface</b>	Analog or digital (X/Y or mag/angle) <i>Cartesian or polar control modes</i>

## GEOMETRIC CONFIGURATION

<b>Coil Arrangement</b>	Orthogonal nested pairs <i>Inner pair perpendicular to outer pair</i>
<b>Working Volume</b>	Sphere ~40% of inner coil diameter <i>Both axes uniform in this region</i>
<b>Coil Former Material</b>	G-10 fiberglass or aluminum <i>Non-magnetic, thermally stable</i>
<b>Mounting Frame</b>	Aluminum or stainless steel <i>Adjustable orthogonal geometry</i>
<b>Access Ports</b>	Four-way access through coil bores <i>Sample insertion along any axis</i>
<b>Weight Range</b>	5–1000 kg (size dependent) <i>Two complete Helmholtz pairs</i>

## PERFORMANCE SCALING EXAMPLES

<b>100mm Inner / 200mm Outer</b>	~300 A·turns per axis @ 50mT <i>~3kW total, benchtop system</i>
<b>200mm Inner / 400mm Outer</b>	~900 A·turns per axis @ 50mT <i>~10kW total, standard lab</i>
<b>300mm Inner / 600mm Outer</b>	~1350 A·turns per axis @ 50mT <i>~15kW total, large working volume</i>
<b>300mm Inner / 600mm Outer</b>	~2700 A·turns per axis @ 100mT <i>~30kW total, water cooling essential</i>
<b>500mm Inner / 1000mm Outer</b>	~2250 A·turns per axis @ 50mT <i>~25kW total, facility installation</i>
<b>300mm Inner / 600mm Outer</b>	~5400 A·turns per axis @ 200mT <i>~60kW pulsed, &lt;10% duty</i>

## VECTOR FIELD CONTROL

<b>Control Modes</b>	Cartesian (B <sub>x</sub> , B <sub>y</sub> ) or Polar (B, $\theta$ ) <i>Software-selectable coordinate systems</i>
<b>Static Vector Fields</b>	Any angle 0–360° in plane <i>Programmable field direction</i>

<b>Rotating Fields</b>	0.001–10 Hz typical <i>Limited by inductance and PSU slew rate</i>
<b>Field Synthesis</b>	Arbitrary waveforms per axis <i>AC susceptibility, hysteresis measurements</i>
<b>Vector Accuracy</b>	<0.5° angular, <0.1% magnitude <i>With calibration and feedback</i>
<b>Field Monitoring</b>	Dual Hall probes or vector magnetometer <i>Real-time 2D field measurement</i>

Nested orthogonal configurations · Inner coil 100–500mm · Outer coil 200–1000mm · Vector fields 30–283mT · Dual independent power

MODEL	CONFIG	PER-AXIS (CONT)	PER-AXIS (PULSED)	VECTOR FIELD	VOLUME	POWER	APPLICATIONS	LEAD
<b>WE-HC2-100/200</b>	100mm inner / 200mm outer <i>Compact benchtop</i>	<b>100 mT</b> <i>Water-cooled</i>	180 mT <i>10% duty</i>	<b>141 / 255 mT</b> <i>Cont./Pulsed</i>	~40mm sphere <i>&lt;1% uniform</i>	6–12 kW <i>Dual PSU</i>	Vector sensor cal, 2D magnetometry <i>Small sample</i>	12 wks
<b>WE-HC2-150/300</b>	150mm inner / 300mm outer <i>Std benchtop</i>	<b>100 mT</b> <i>Water-cooled</i>	160 mT <i>10% duty</i>	<b>141 / 226 mT</b> <i>Cont./Pulsed</i>	~60mm sphere <i>&lt;1% uniform</i>	8–16 kW <i>Dual PSU</i>	Anisotropic materials, rotating fields <i>Good balance</i>	12 wks
<b>WE-HC2-200/400</b>	200mm inner / 400mm outer <i>Medium lab</i>	<b>80 mT</b> <i>Water-cooled</i>	140 mT <i>10% duty</i>	<b>113 / 198 mT</b> <i>Cont./Pulsed</i>	~80mm sphere <i>&lt;1% uniform</i>	10–18 kW <i>Independent circuits</i>	Larger samples, susceptibility <i>Moderate field</i>	14 wks
<b>WE-HC2-300/600</b>	300mm inner / 600mm outer <i>Most common</i> ★	<b>100 mT</b> <i>Water-cooled</i>	200 mT <i>10% duty</i>	<b>141 / 283 mT</b> <i>Cont./Pulsed</i> ★	~120mm sphere <i>&lt;1% uniform</i>	16–24 kW <i>Synced dual PSU</i>	Vector synthesis, 2D mapping, magneto-optics <i>Industry std</i>	14 wks
<b>WE-HC2-400/800</b>	400mm inner / 800mm outer <i>Large volume</i>	<b>70 mT</b> <i>Water-cooled</i>	120 mT <i>10% duty</i>	<b>99 / 170 mT</b> <i>Cont./Pulsed</i>	~160mm sphere <i>&lt;1% uniform</i>	20–32 kW <i>High-power dual</i>	Large assembly, multi-sensor arrays <i>Significant access</i>	16 wks
<b>WE-HC2-500/1000</b>	500mm inner / 1000mm outer <i>Facility scale</i>	<b>60 mT</b> <i>Water-cooled</i>	100 mT <i>10% duty</i>	<b>85 / 141 mT</b> <i>Cont./Pulsed</i>	~200mm sphere <i>&lt;1% uniform</i>	25–40 kW <i>Facility-scale</i>	Large-volume calibration, metrology <i>Max volume</i>	18 wks
<b>WE-HC2-CUSTOM</b>	Custom inner/outer <i>100–1000mm</i>	<b>Custom</b> <i>Optimized</i>	Custom <i>To spec</i>	<b>App-specific</b> <i>Tailored</i>	App-specific <i>Optimized</i>	App-specific <i>Dual PSU sized</i>	Unique research requirements <i>Full custom</i>	16–24 wks

#### NOTES:

- All systems include two orthogonal Helmholtz coil pairs, mounting frame, dual water manifolds, and field uniformity certification
- Two independent DC power supplies required — contact WE for dual PSU with synchronized control capability
- Vector field is  $\sqrt{2} \times$  per-axis field when both axes at same magnitude (e.g., 100mT each → 141mT vector)
- Control modes: Cartesian (Bx, By) or Polar (magnitude, angle). Rotating field capability 0.001–10 Hz typical

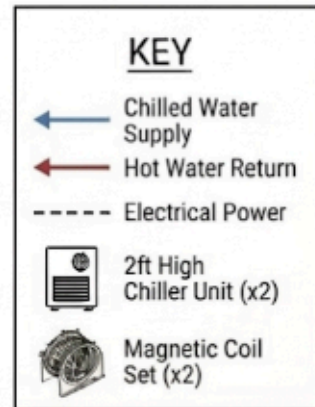
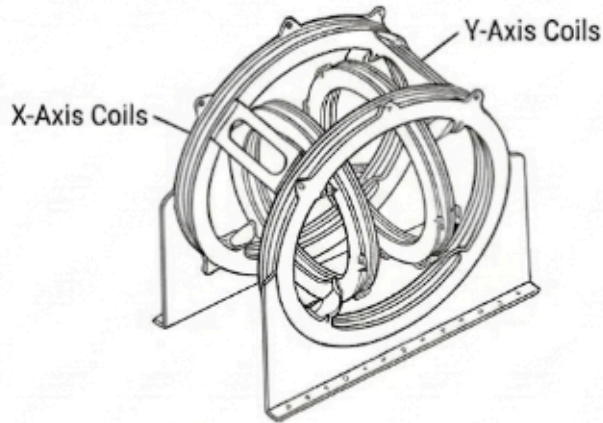
### Connection schematic of the two axis HH coil

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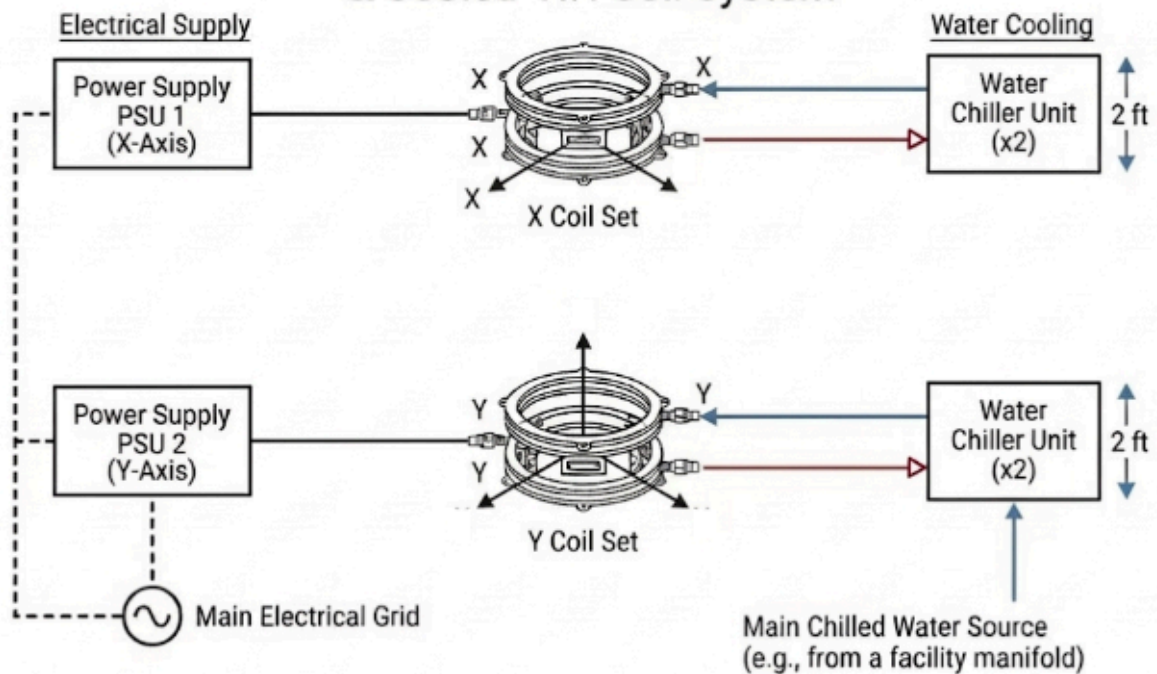
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## 2-Axis independently Controlled & Cooled HH Coil System



# Helmholtz Coil System

## Technical Specification Form

Please complete all sections below. This information will be used to prepare a detailed quotation and ensure the system meets your requirements. If you have questions about any specification, contact us at [sales@woodruffeng.com](mailto:sales@woodruffeng.com)

### CUSTOMER INFORMATION

<b>Organization / Institution</b>	
<b>Contact Name</b>	
<b>Email Address</b>	
<b>Phone Number</b>	
<b>Shipping Address</b>	

### SYSTEM CONFIGURATION

<b>Number of Axes</b>	<input type="checkbox"/> 1-axis (single coil pair) <input type="checkbox"/> 2-axis (X-Y planar) <input type="checkbox"/> 3-axis (X-Y-Z)
<b>Innermost Coil Diameter</b>	_____ mm (Typical range: 100–1000mm)
For multi-axis systems:	Outermost coil diameter: _____ mm
<b>Coil separation</b>	<input type="checkbox"/> Standard Helmholtz ( $d = R$ ) <input type="checkbox"/> Custom (specify): _____

### FIELD REQUIREMENTS

<b>Maximum Field Per Axis(Continuous Operation)</b>	_____ mT (Typical range: 10–200mT continuous)
<b>Peak Field Per Axis(Pulsed, if needed)</b>	_____ mT at _____ % duty cycle
<b>Maximum Vector Field(for multi-axis systems)</b>	_____ mT (2-axis: $\sqrt{2}$ × per-axis; 3-axis: $\sqrt{3}$ × per-axis)

### WORKING VOLUME & UNIFORMITY

<b>Required Uniform Volume(diameter or radius)</b>	_____ mm (Typically 30–50% of innermost coil diameter)
<b>Field Uniformity Specification</b>	<input type="checkbox"/> <0.5% <input type="checkbox"/> <1% <input type="checkbox"/> <2% <input type="checkbox"/> Other: _____%
Uniformity measured over:	<input type="checkbox"/> Central sphere <input type="checkbox"/> Central cylinder (1-axis) <input type="checkbox"/> Other:

## OPERATING FREQUENCY & POWER SUPPLY

<b>Operating Mode</b>	<input type="checkbox"/> DC only <input type="checkbox"/> AC capable <input type="checkbox"/> Both
If AC capable, frequency range:	DC to _____ Hz   (Typical: DC–100Hz or DC–1000Hz)
<b>Waveform Requirements</b>	<input type="checkbox"/> DC <input type="checkbox"/> Sine <input type="checkbox"/> Triangle <input type="checkbox"/> Square <input type="checkbox"/> Arbitrary
<b>For multi-axis, rotating fields?</b>	<input type="checkbox"/> Not required <input type="checkbox"/> Yes (specify rotation rate): _____ Hz
<b>Power Supply Preference</b>	<input type="checkbox"/> Woodruff Engineering supply <input type="checkbox"/> Customer-provided
If customer-provided:	Current capability: _____ A   Voltage: _____ V

## COOLING & INSTALLATION

<b>Cooling Method</b>	<input type="checkbox"/> Air-cooled <input type="checkbox"/> Water-cooled <input type="checkbox"/> Forced air
If water-cooled:	Available water flow: _____ L/min   Pressure: _____ PSI
<b>Mounting Configuration</b>	<input type="checkbox"/> Benchtop <input type="checkbox"/> Floor-standing <input type="checkbox"/> Custom frame
<b>Access requirements</b>	<input type="checkbox"/> Horizontal bore <input type="checkbox"/> Vertical bore <input type="checkbox"/> Both (3-axis)

## SPECIAL REQUIREMENTS & NOTES

<b>Computer Control Interface</b>	<input type="checkbox"/> Not required <input type="checkbox"/> USB <input type="checkbox"/> Ethernet <input type="checkbox"/> RS-232
<b>Control Software</b>	<input type="checkbox"/> Standalone GUI <input type="checkbox"/> LabVIEW compatible <input type="checkbox"/> Python API
<b>Field Sensors / Feedback</b>	<input type="checkbox"/> Open-loop <input type="checkbox"/> Closed-loop (Hall probe feedback)
<b>Coordinate system control</b>	<input type="checkbox"/> Cartesian (Bx, By, Bz) <input type="checkbox"/> Spherical (B, $\theta$ , $\phi$ )
<b>Budget Range (optional)</b>	\$ _____ to \$ _____
<b>Target Delivery Date</b>	_____ (Typical lead times vary between 8–26 weeks)

**Additional Requirements or Notes:**

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## SUBMISSION

**Please email this completed form to: [sales@woodruffeng.com](mailto:sales@woodruffeng.com)**

We will review your specifications and provide a detailed quotation within 3–5 business days. If clarification is needed on any requirements, we will contact you directly.