# 5204 Electromagnet

## OVERVIEW

The 5204 electromagnet is a projected vector field magnet providing field of any orientation at a location above the magnet surface. It is intended for applications where the space around the working volume needs to be freely accessible. A clear path exists all the way through with Ø2.5mm, this allows optical access from the beneath.

Custom pole extensions may be located on the pole faces in order to achieve desired field properties for a specific application. The 5204 can be mounted in any orientation and the light weight (2.5kg) allows the magnet to be integrated into dynamic applications such as wafer testing.

## Features

- Projected Vector Field up to 0.3T
- Interchangeable Pole Extensions
- Small and Lightweight
- Any Mounting Orientation
- Up to 200Hz Operation

## Applications

- Spintronic Devices
- Hall Effect Studies
- Magneto-Optical Studies
- Point Defect Research, Particularly Nitrogen-Vacancy Centers
- Biological Studies

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# Model 5204 General Specifications

## Mechanical

| | |
|---|---|
| Dimensions | 74mm W x 74mm D x 123.5mm H |
| Weight (excluding hoses and water) | 2.5kg |
| Peak Operating Field | Br=±550mT, Bz=±140mT |
| Axial Viewing Port | Ø2.5mm |
| Routing of Water Hoses and Electrical Cables | base or side |

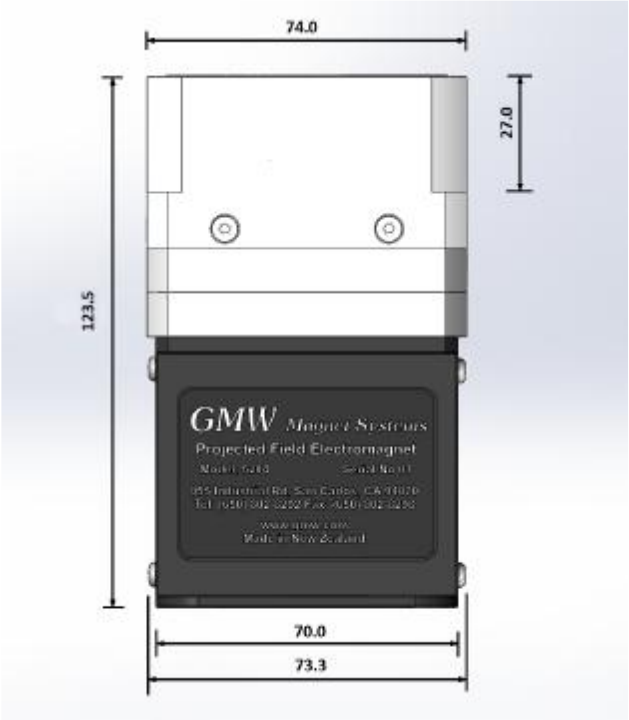
## Coils (3 coils per magnet)

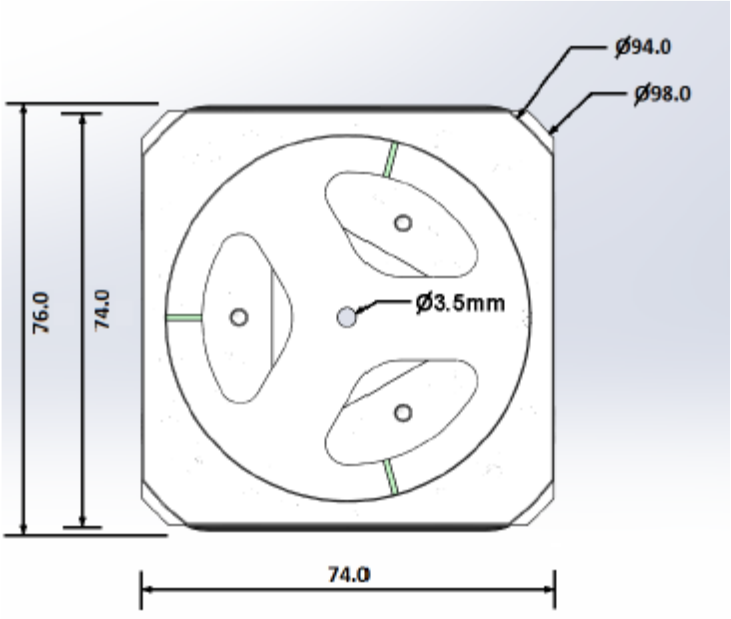
| | |
|---|---|
| Resistance (20°C) | 36.8mΩ |
| Max. Resistance (80°C) | 45.2mΩ |
| Max. Continuous Current | 62A |
| Max. Peak Current | 100A |
| Max. Continuous Power | 175W/coil |
| Max. Peak Power | 450W/coil |
| Coil Inductance | 127μH/coil |
| Water Cooling (supply 18°C @60psid) | 8liters/min |
| Anticipate Max. Sinusoidal Frequency | 200Hz |

## Safety

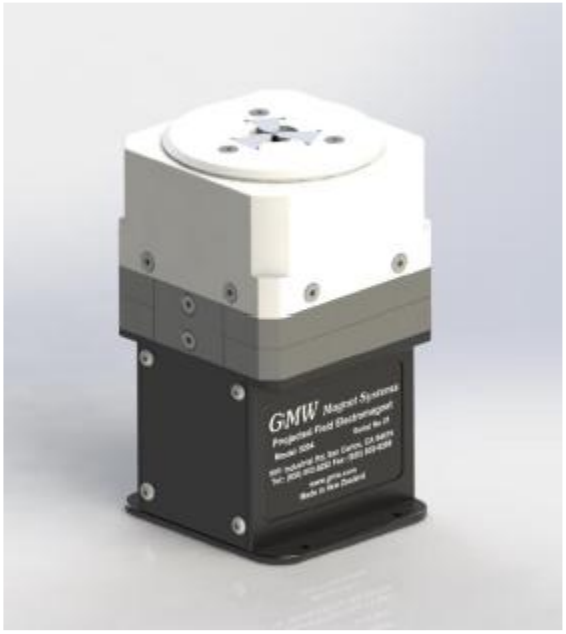
| | |
|---|---|
| Over Temperature Interlock | Selco UP62-082C thermostat. Open circuit above 80°C coil temp |
| Water Flow | GEM FS380/168435 flow switch. 0.51liters/min |

**General Assembly**

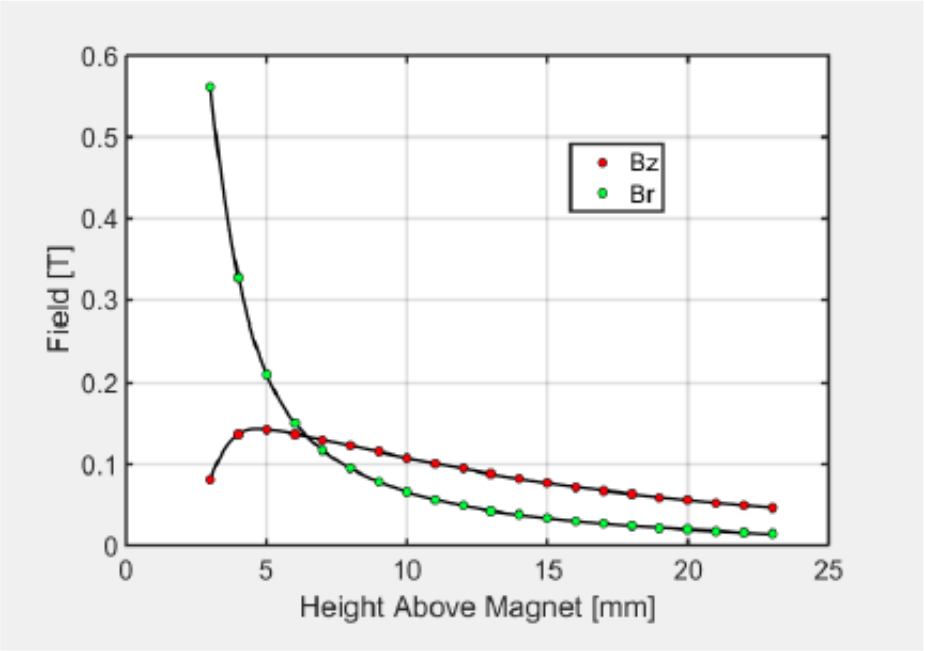


Magnet with 3mm Flux Plate

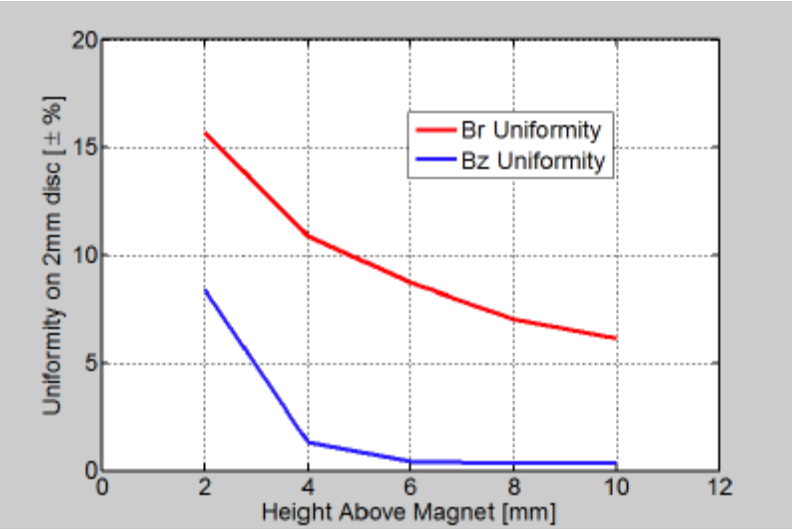



Field Strength Versus Height above Magnet (63A operation) Magnet fitted with 3mm Flux Plate

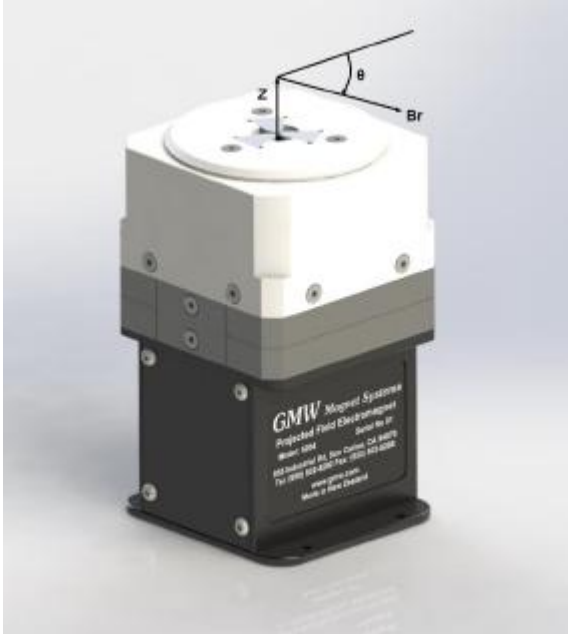



Note, Bz values are taken with all three coils equally energized so as to direct flux vertically. Br values are taken with one coil sourcing magnetic flux, one sinking magnetic flux and the other unpowered.

Field Uniformity on a Ø2mm Disc Versus Height Above Magnet



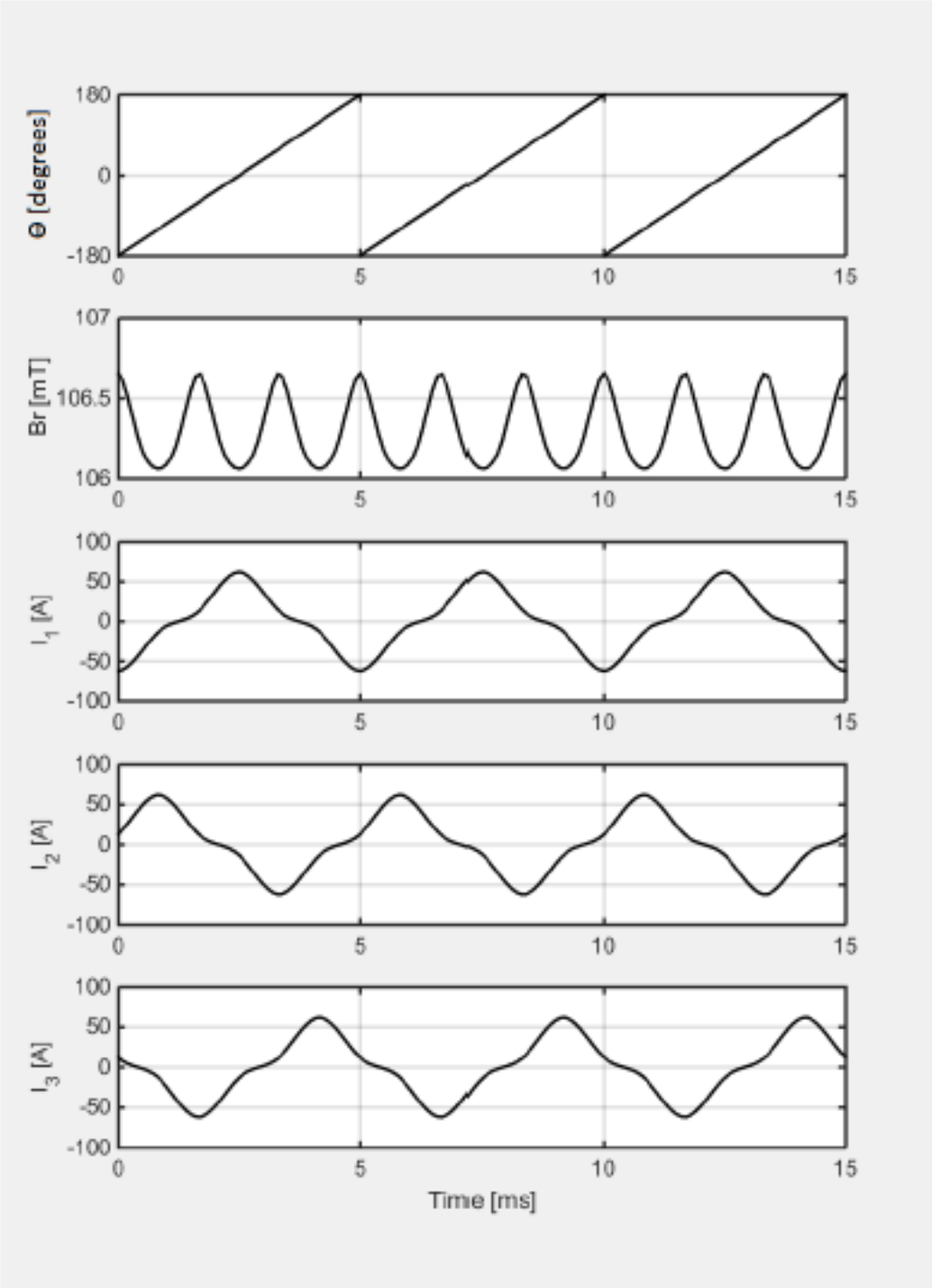

Application Note



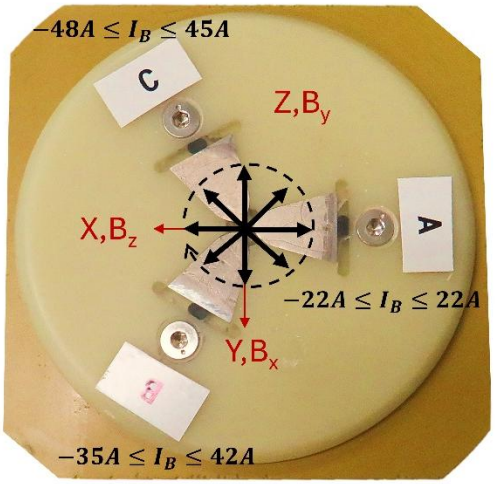

Field is measured at 5mm above top of flux plate.

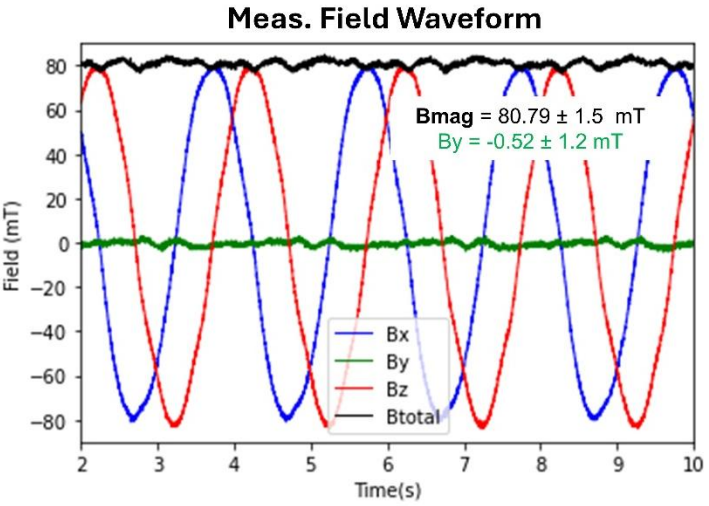
The magnet is fitted with the 3mm flux plate and the excitation curves for each of the three coils are calculated to provide a rotating field of 106 mT in plane at 5mm above the condenser plate. The field rotates at 200 Hz with very low ripple (~0.5 mT) and <0.1 mT of Bz component.

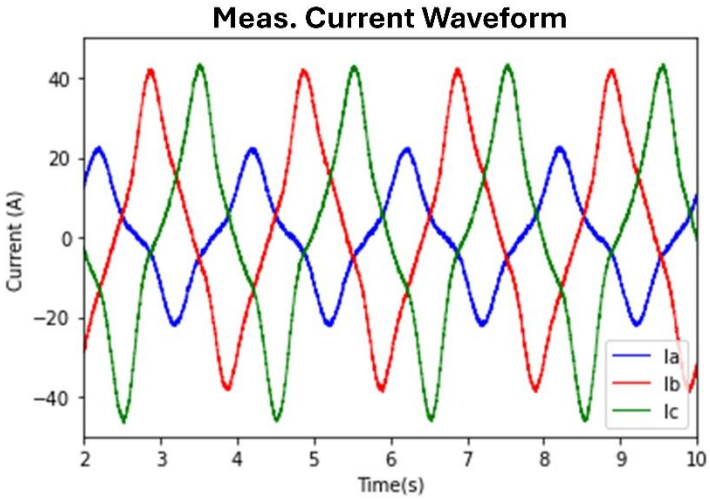
To create a rotating in-plane field the three coils are excited by a waveform with 120° phase angle between each. The waveform is not an ideal sinusoid due to non-linear saturation effects. The residual ripple can be reduced by refinement of the applied waveform.



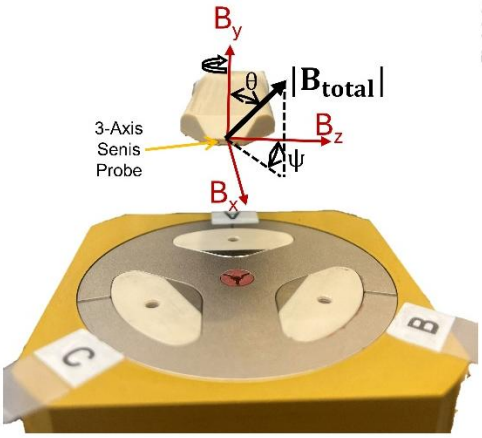
**80mT continuous in-plane rotating field at 5mm height**

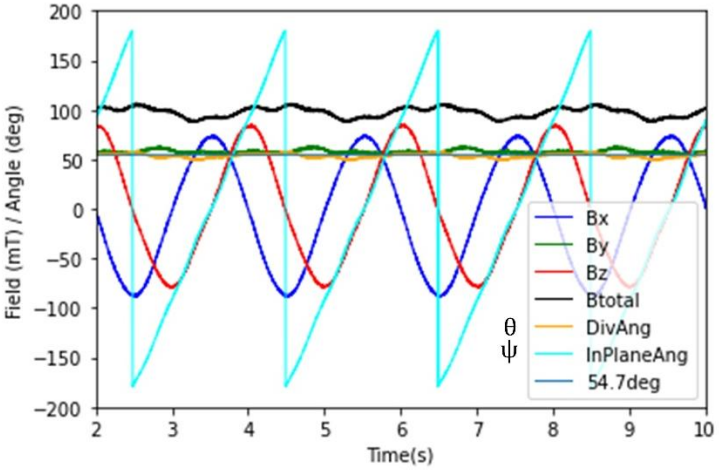


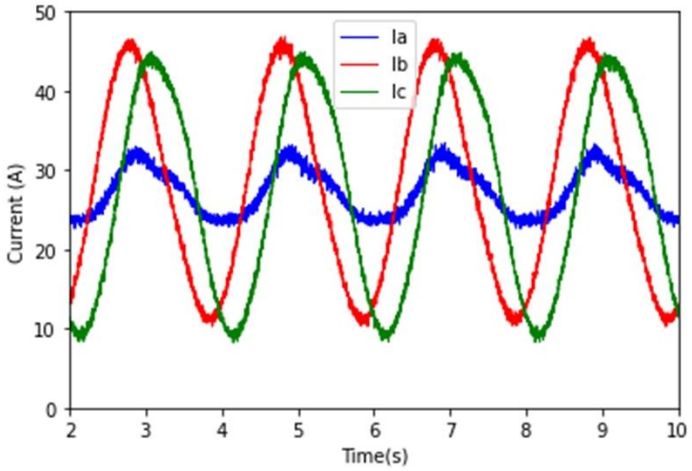



**Continuous Rotating Azimuthal Angle ($-180° \leq \psi \leq 180°$) & Vertical offset angle $\theta \cong 54.7°$**



100mT peak triangular waveform at 45°
5mm height