

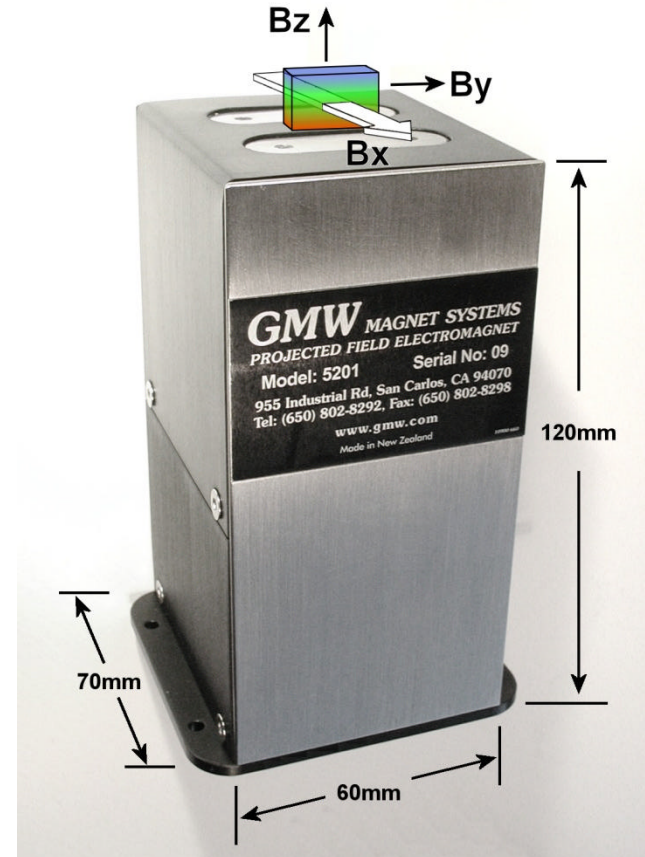
New GMW Electromagnets

- Model 5201: Projected Field Magnet
- Model 5403AC: Laminated Magnet for Fast Field Cycle Applications

Greg Douglas, Yuqiang Qin, Ian Walker, GMW Associates

5201: Projected Field Magnet

- Field: B_x , B_y , B_z
Open access to the sample surface
- B_x ($X=Y=0\text{mm}$, $\pm 20\text{A}$):
 - ~ $\pm 0.4\text{T}$ at $Z=2\text{mm}$
 - ~ $\pm 0.1\text{T}$ at $Z=12\text{mm}$
- B_x uniform volum ($\pm 1\%$):
 $2 \times 10 \times 0.2\text{mm}$ (x, y, z)
- Weight: 2.1kg
- Water cooled for full power
- Small enough to fit in a 95mm ID re entrant vacuum chamber



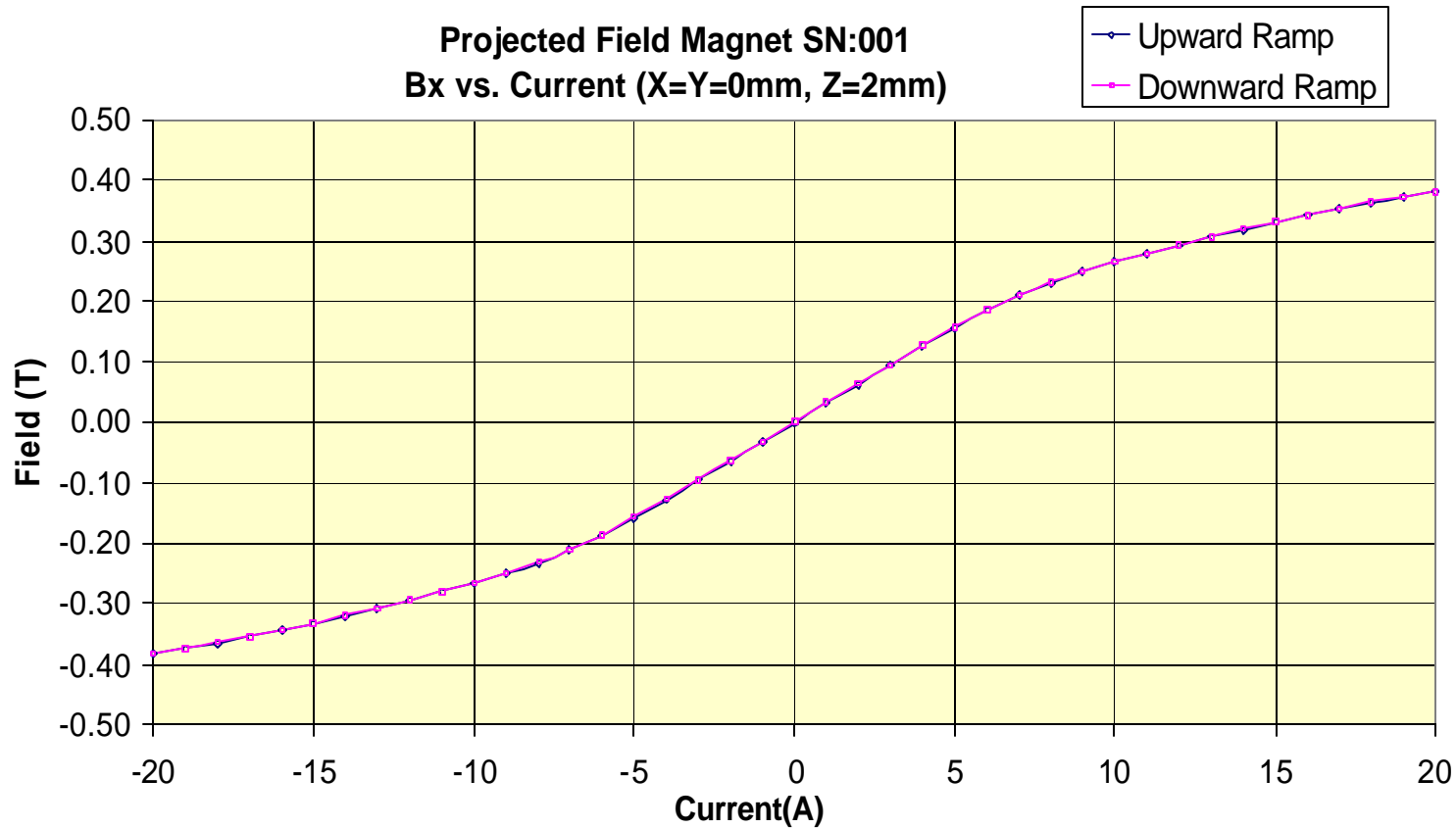
5201: Projected Field Magnet

Application examples:

- In-plane magnetic field effects in magnetic thin film, media and devices. FeRAM, MRAM, MOKE, SMOKE
- Scanning Probe Microscopy, SEMPA, STM, ATF.
- Calibration and test of Hall effect, MR, GMR sensors
- Chemical reaction and biological sample activity study

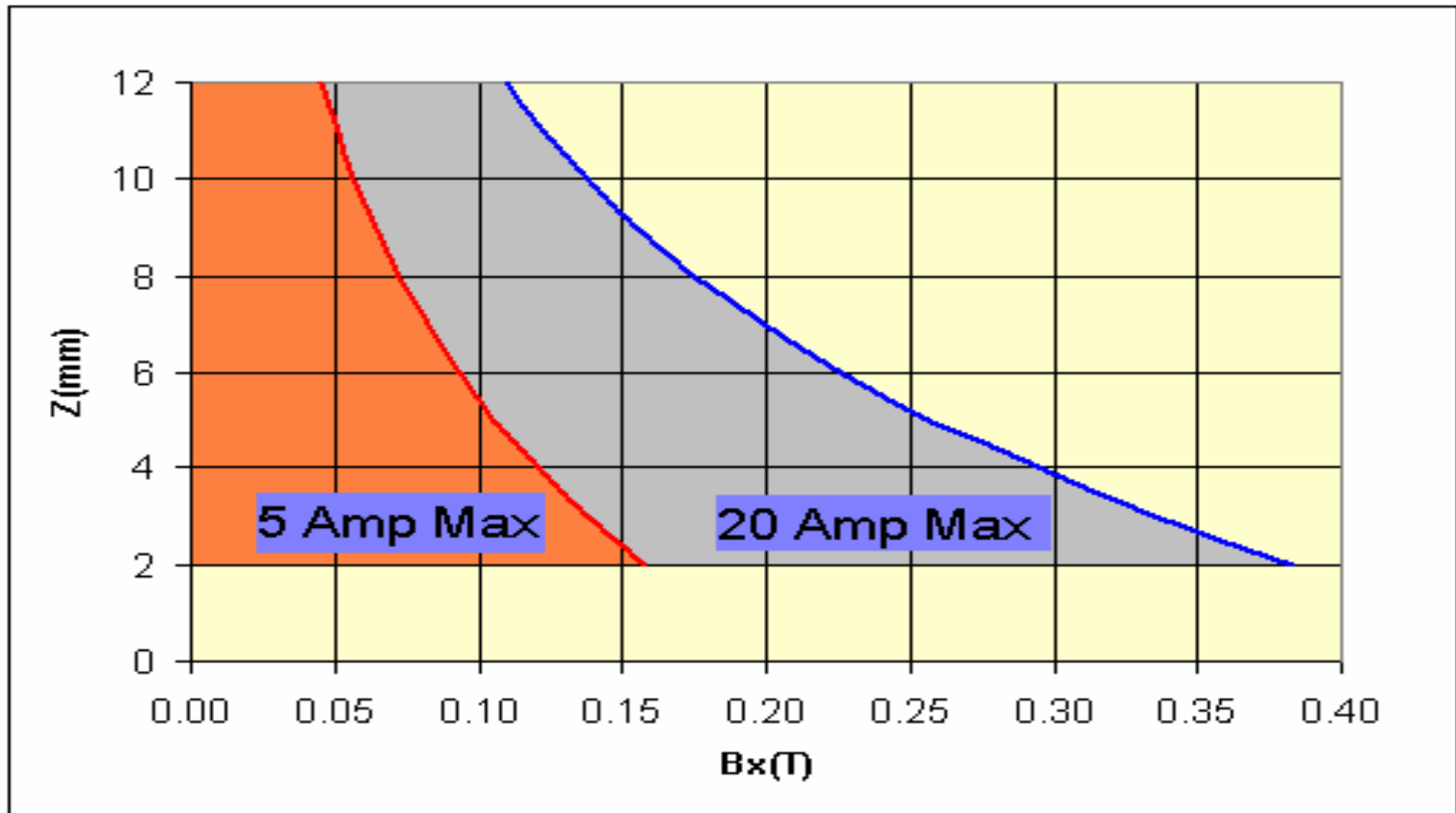
5201: Projected Field Magnet

-B_x vs Current



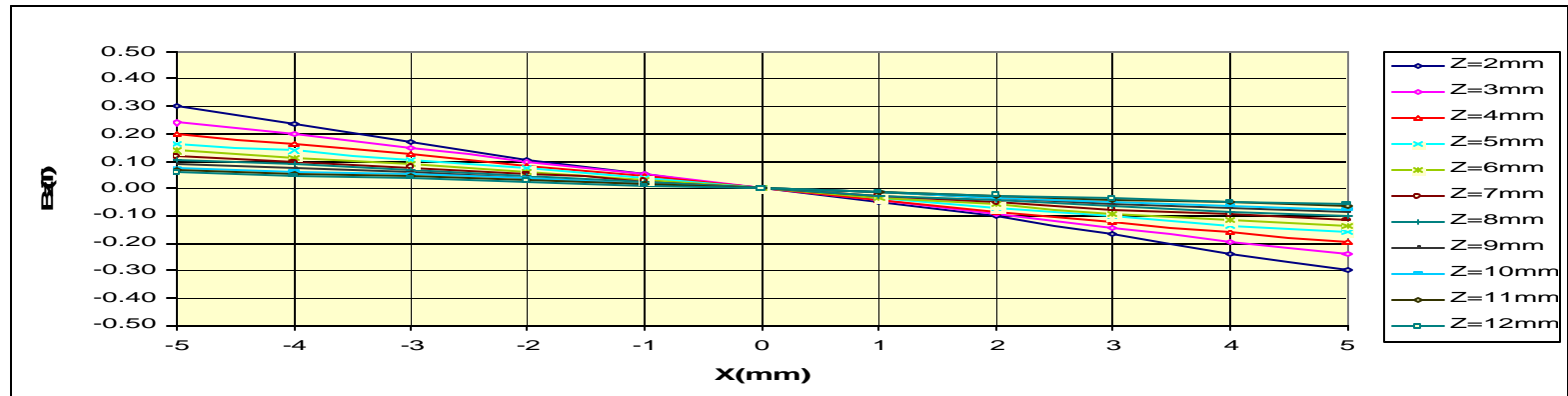
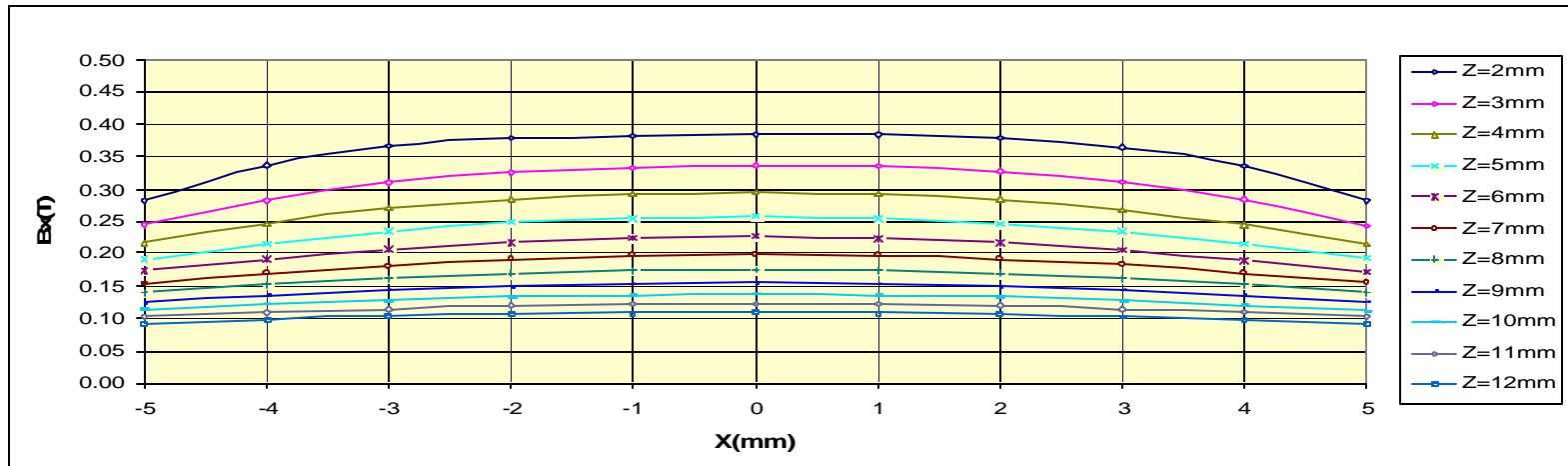
5201: Projected Field Magnet

B_x vs Z



5201: Projected Field Magnet

$-B_x, B_z$ vs X ($Y=0\text{mm}$, $I=20\text{A}$)

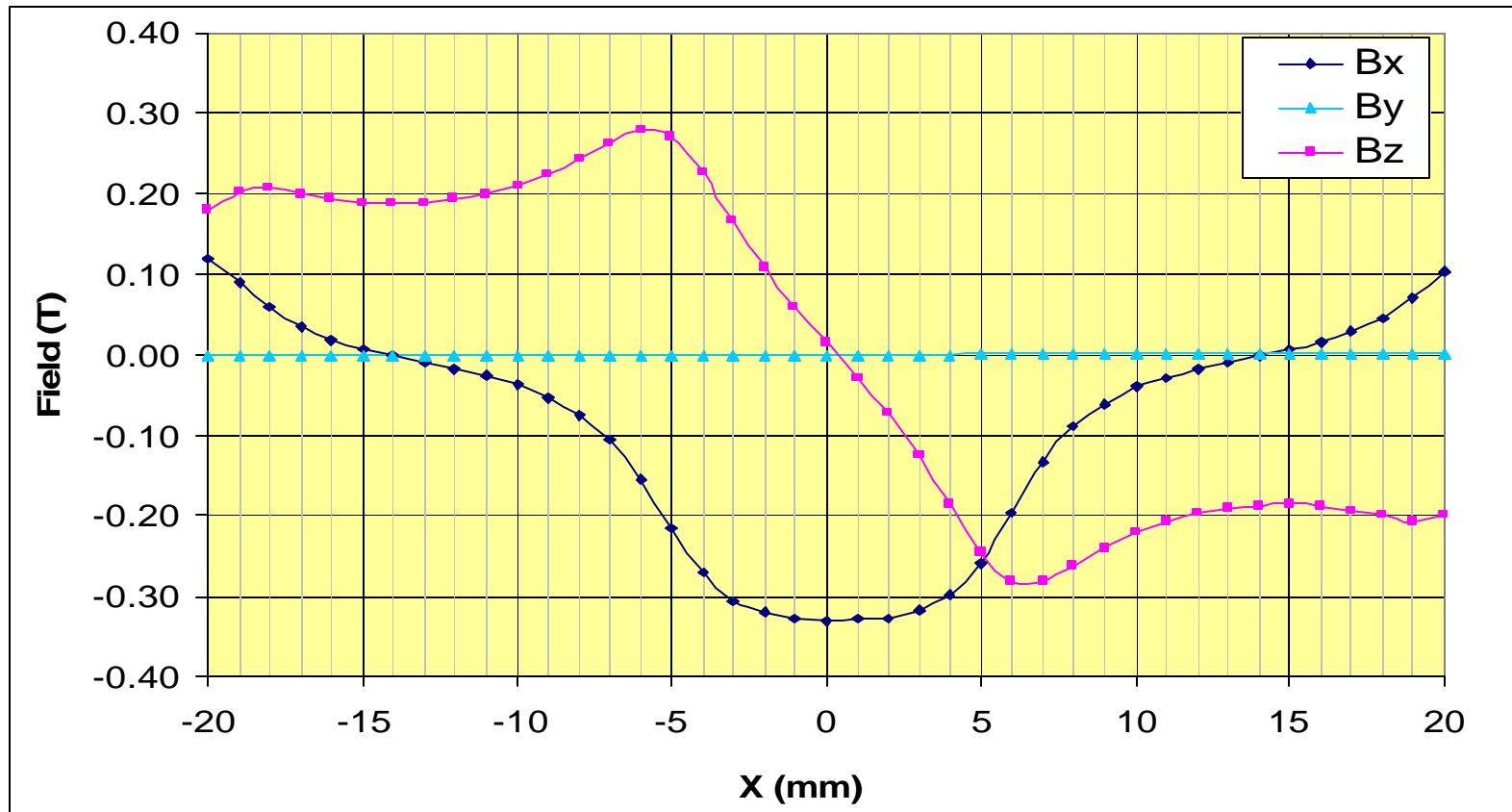


5201: Projected Field Magnet

$-B_x, B_y, B_z$ vs X ($Y=0$ mm, $Z=2$ mm, $I=15$ A)

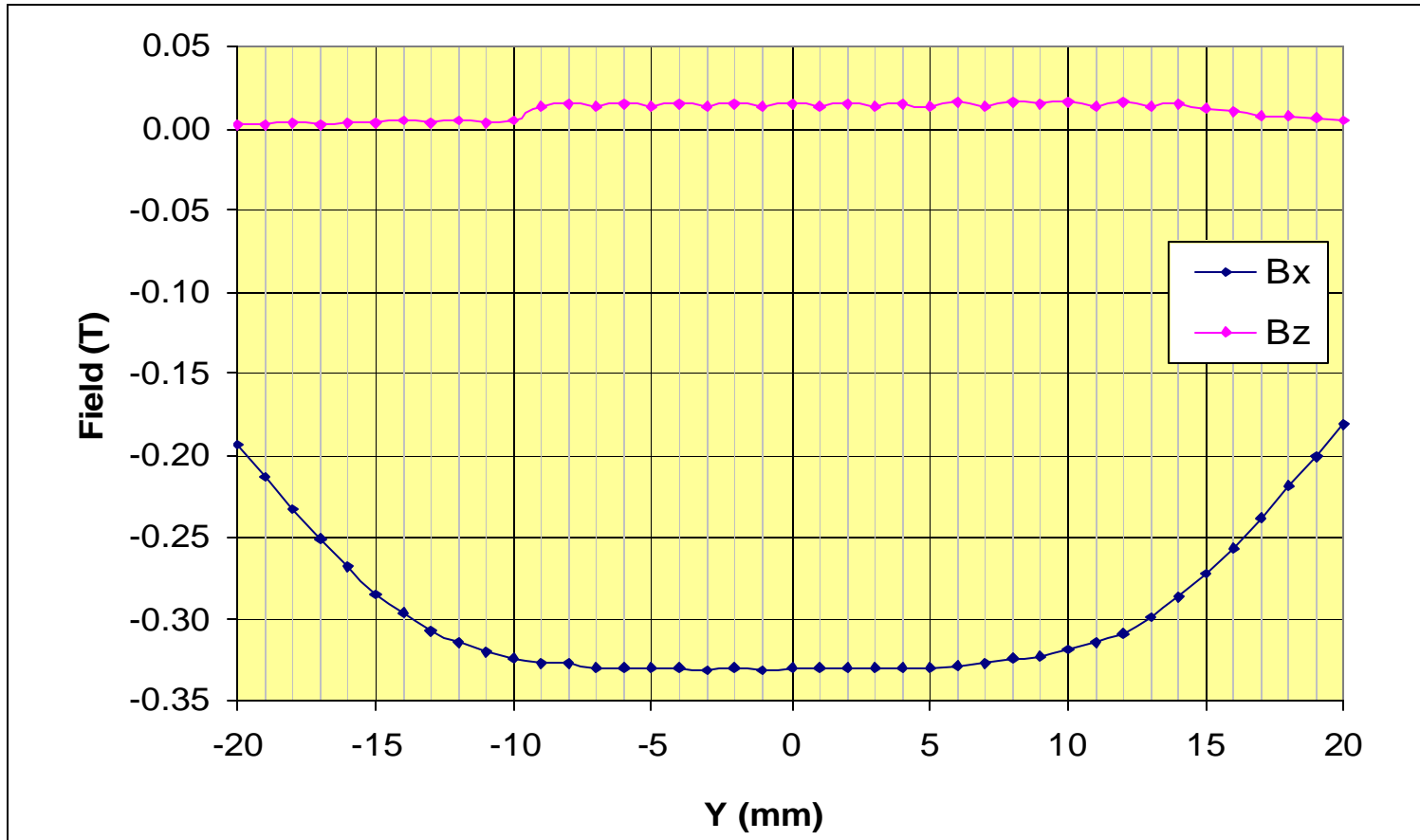
At $X=0$: B_x is max, $B_y=B_z=0$

At $x \sim \pm 14$ mm: B_z is constant, $B_x=B_y=0$



5201: Projected Field Magnet

$-B_x, B_z$ vs Y ($X=0\text{mm}, Z=2\text{mm}, I=15\text{A}$)

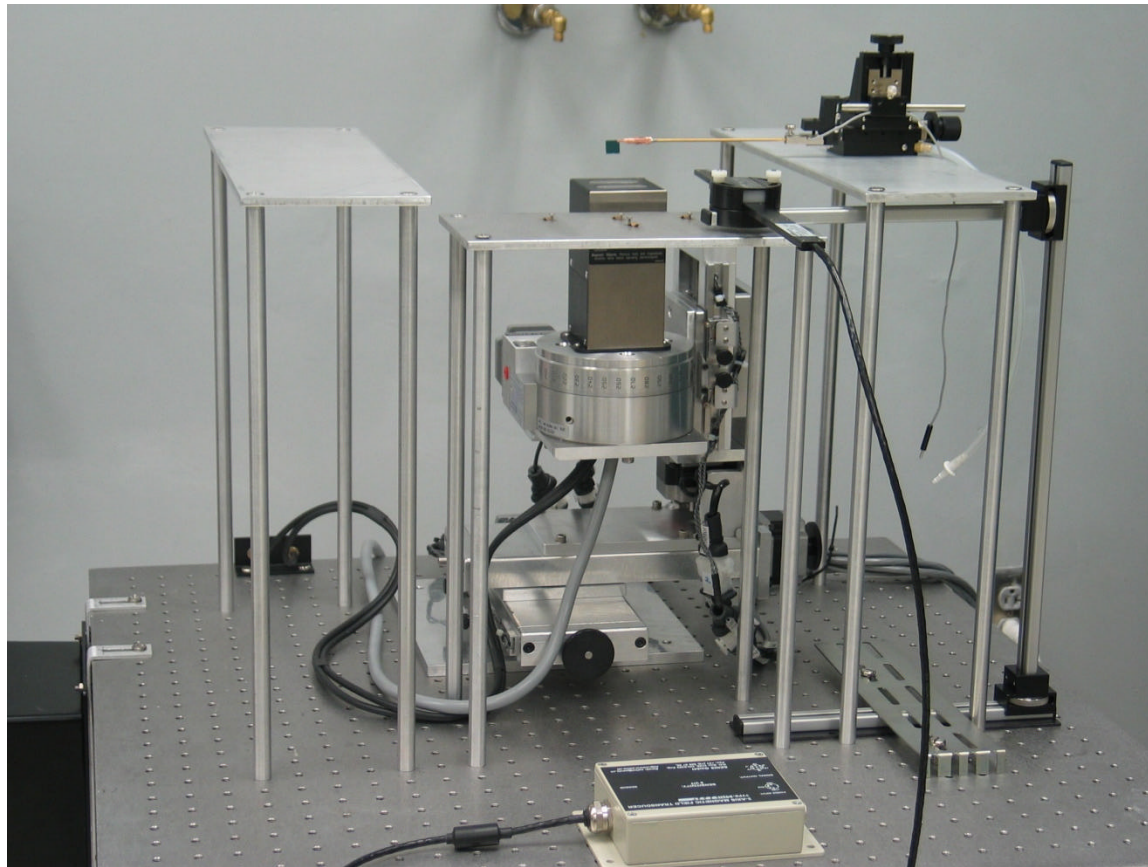


5201: Projected Field Magnet -Motion Control

- Provide linear and rotary motion positioning for the Magnet
- 19" Rack controller for up to four stepper motors
- Interface:
 - GPIB: standard.
 - RS232
 - USB
- Motion Stage Option:
 - X, Y
 - X, Y, T
 - X, Y, Z, T
- LabVIEW Control Software

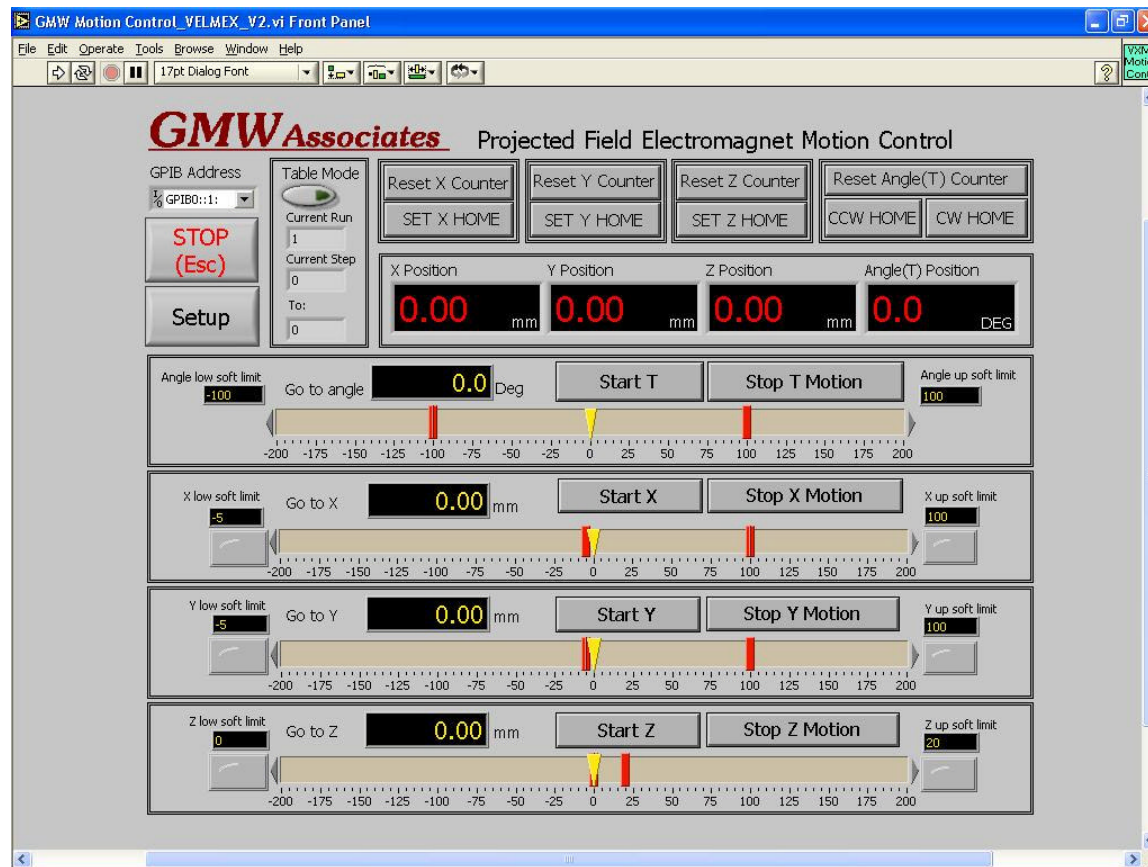
GMW 5201: Projected Field Magnet

-An installed system

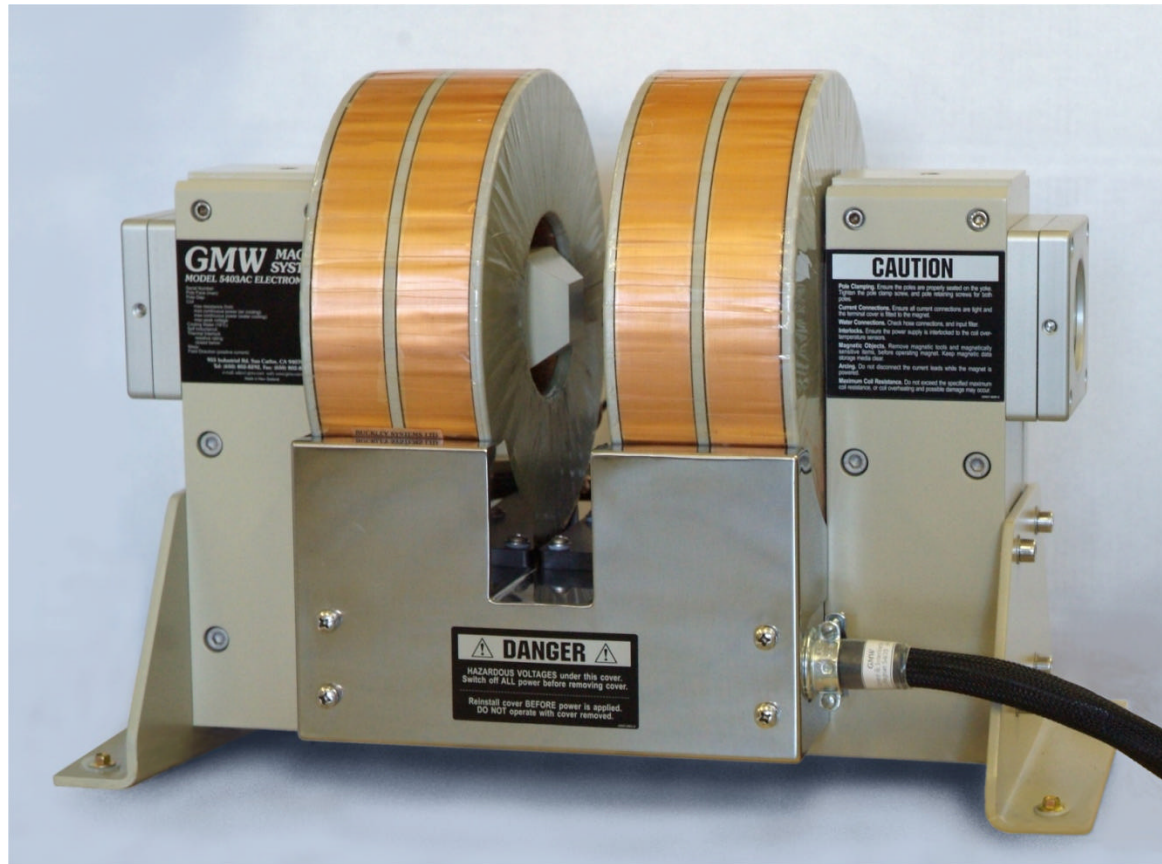


GMW 5201: Projected Field Magnet

-LabVIEW Motion Control Software Screen



GMW 5403AC: Laminated Magnet



GMW 5403AC: Laminated Magnet

-Power supply:

+/-60A, +/- 160V

Bipolar Power Supply
based on 231P gradient
amplifier.

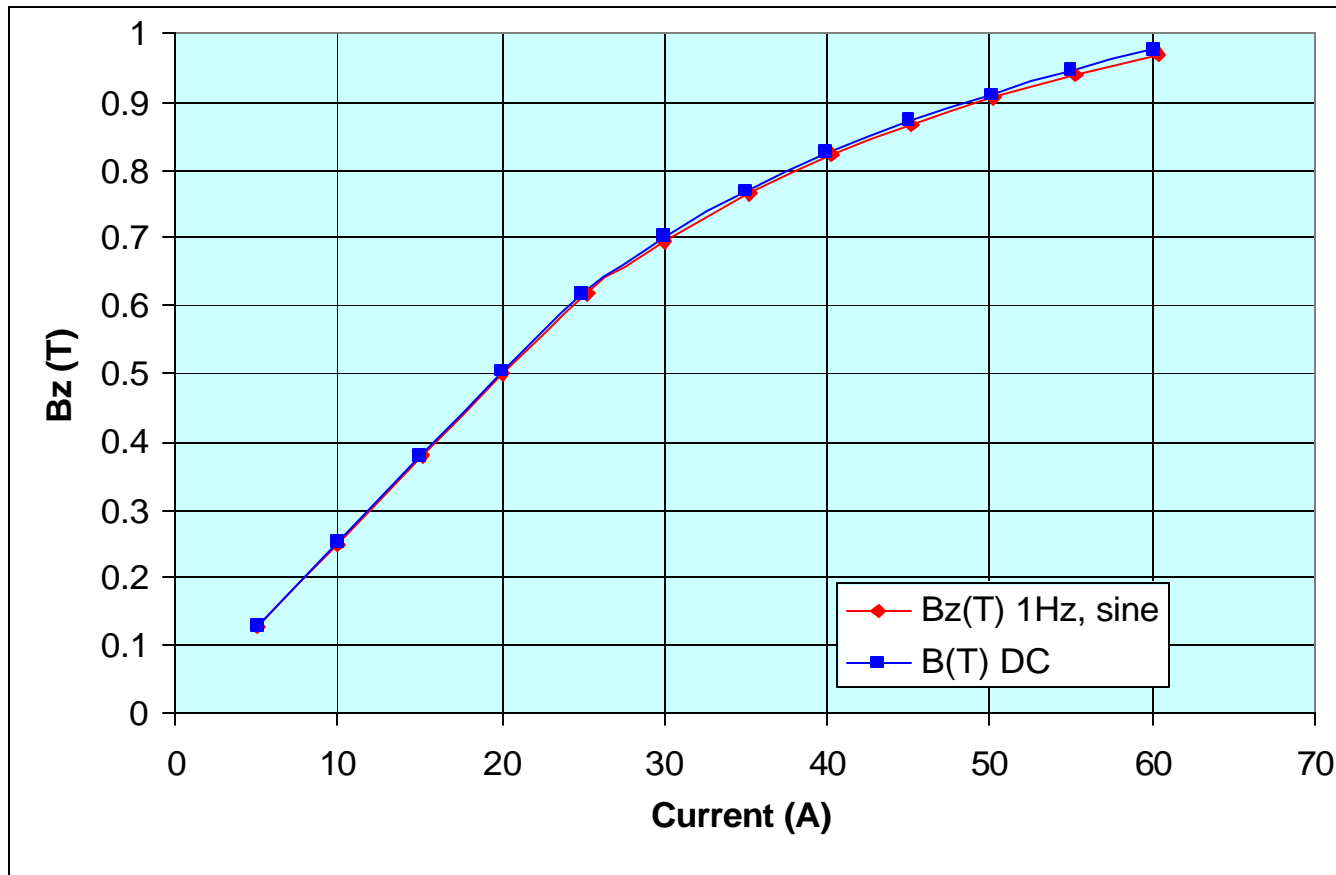


GMW 5403AC: Laminated Magnet

- Laminated poles and yoke
- Fast field ramping and settling
- Low fringe field
- Max field: $\sim 1.0\text{T}$ at 32mm gap, 60A
- Weight: 160kg
- Water cooled for max power

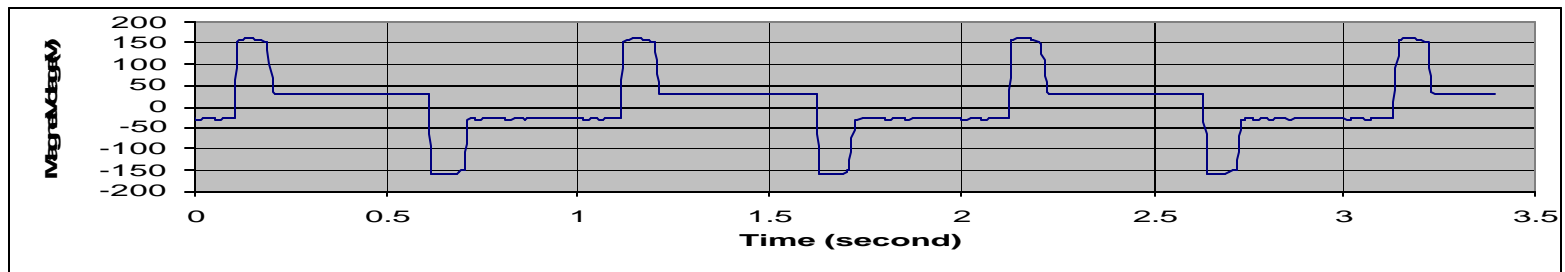
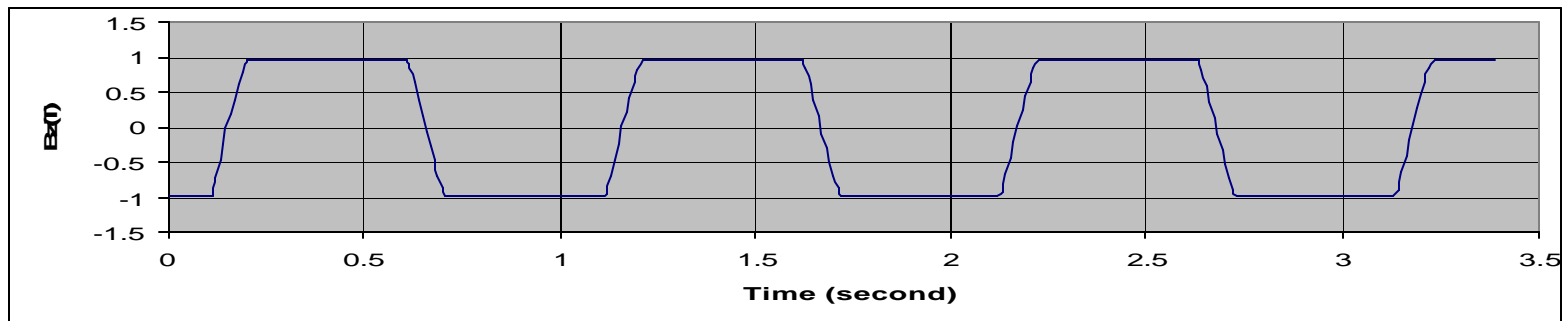
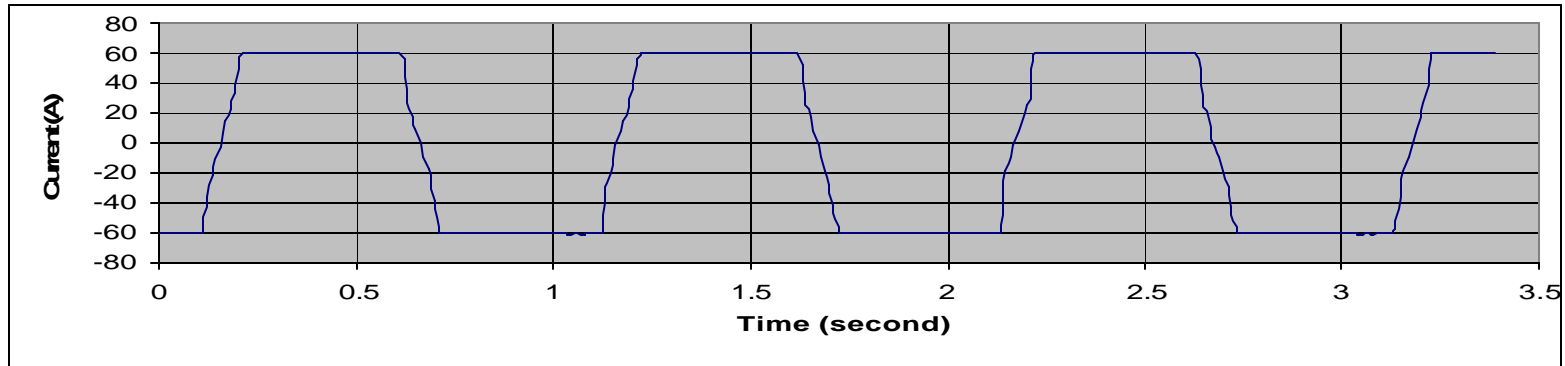
GMW 5403AC: Laminated Magnet

-Excitation curve, Bz vs Current



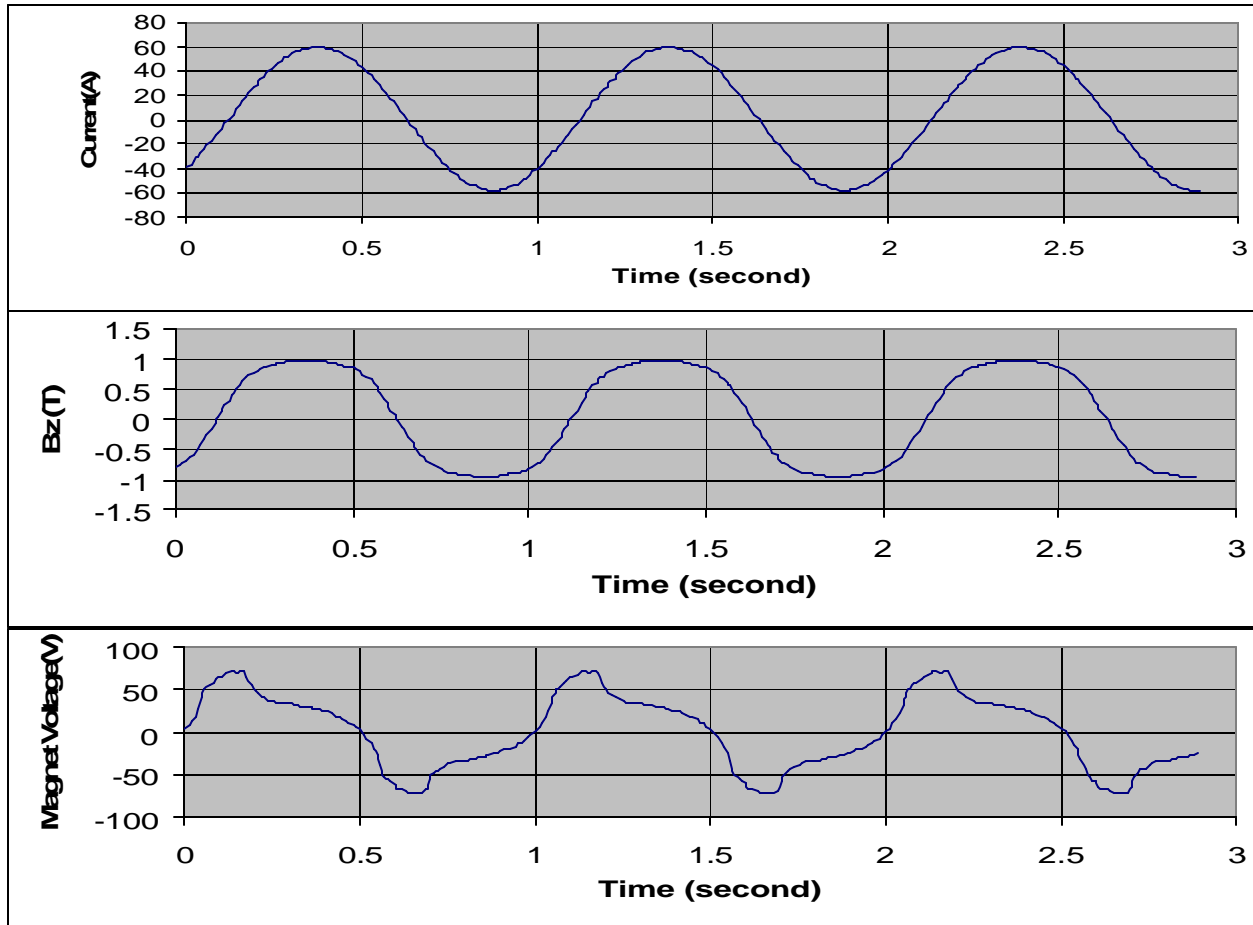
GMW 5403AC: Laminated Magnet

-1 Hz Square wave. 2T transition in 0.1 sec or 20T/sec



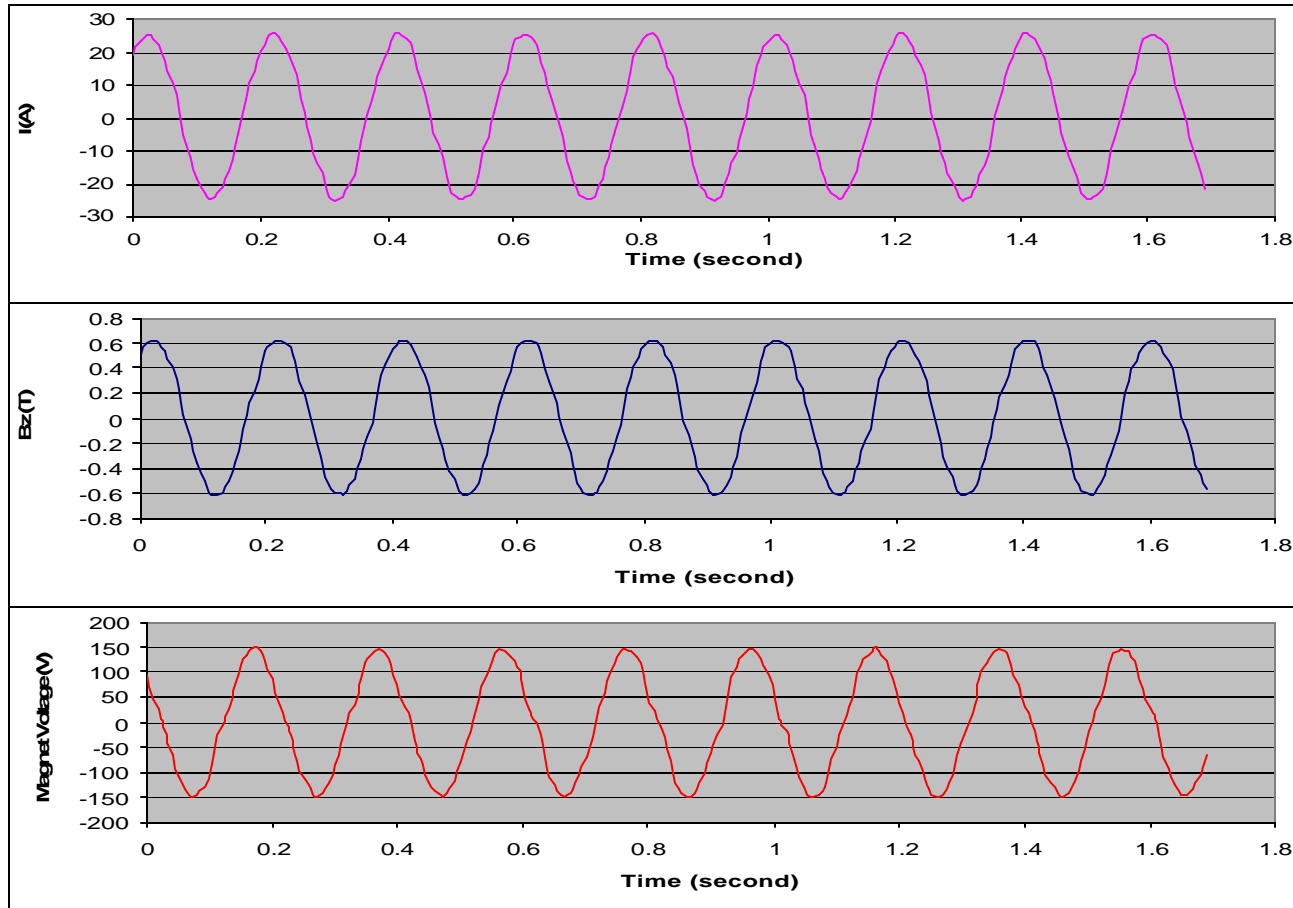
GMW 5403AC: Laminated Magnet

-1 Hz Sine wave



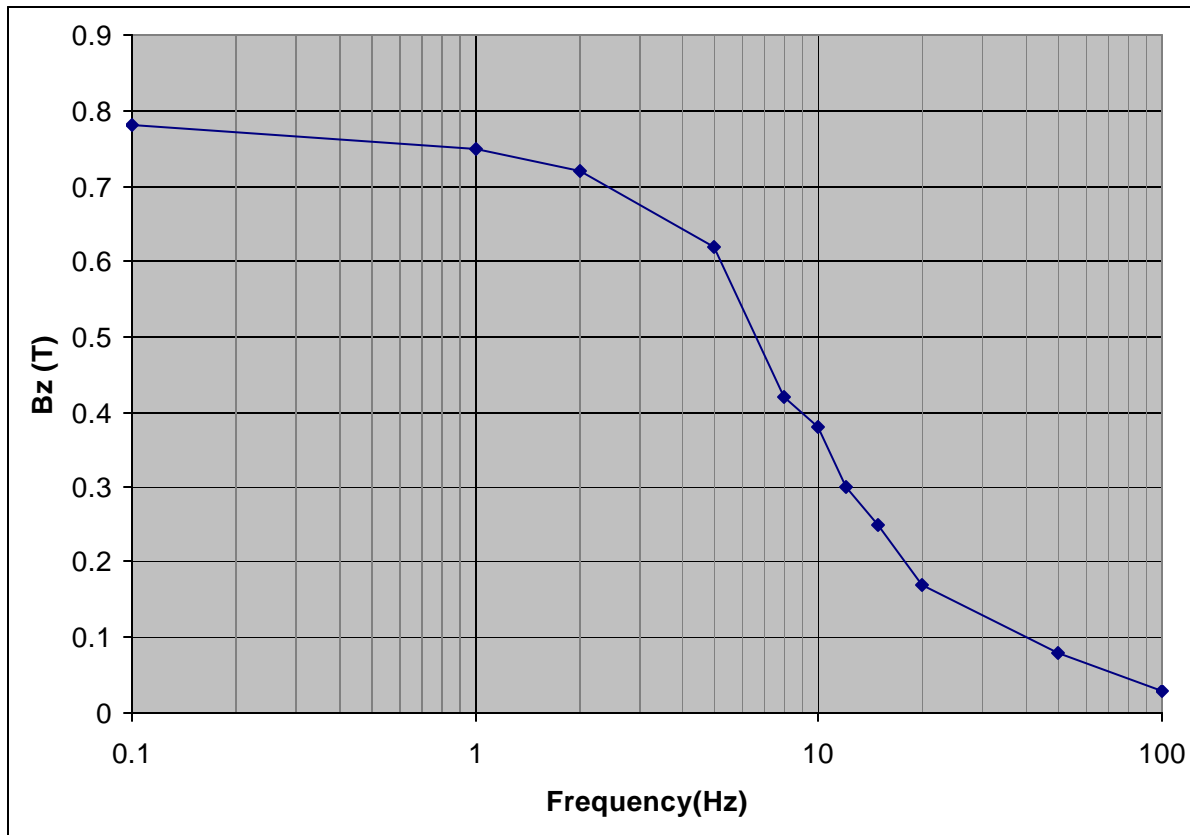
GMW 5403AC: Laminated Magnet

-5 Hz Sine wave



GMW 5403AC: Laminated Magnet

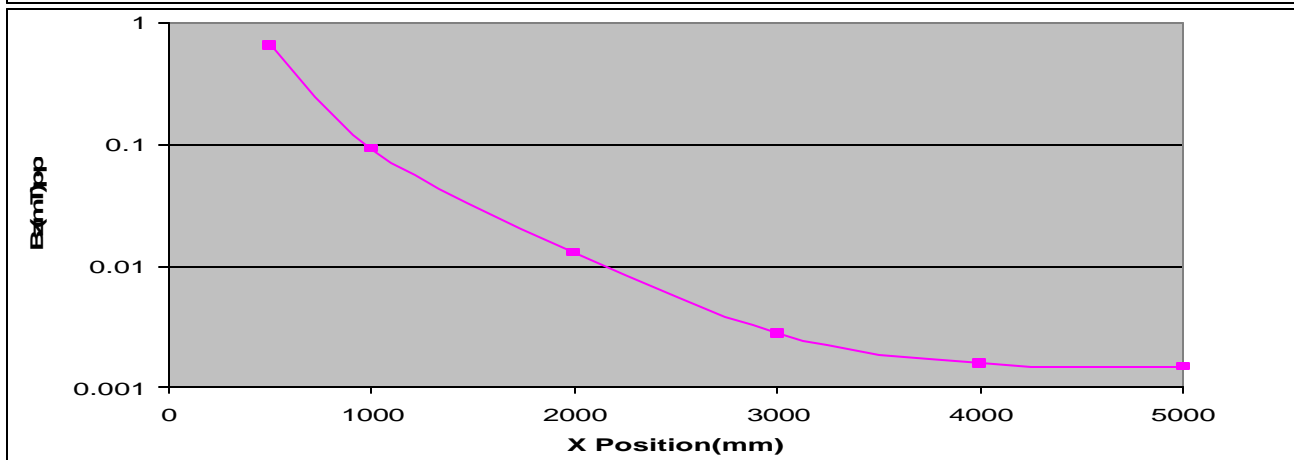
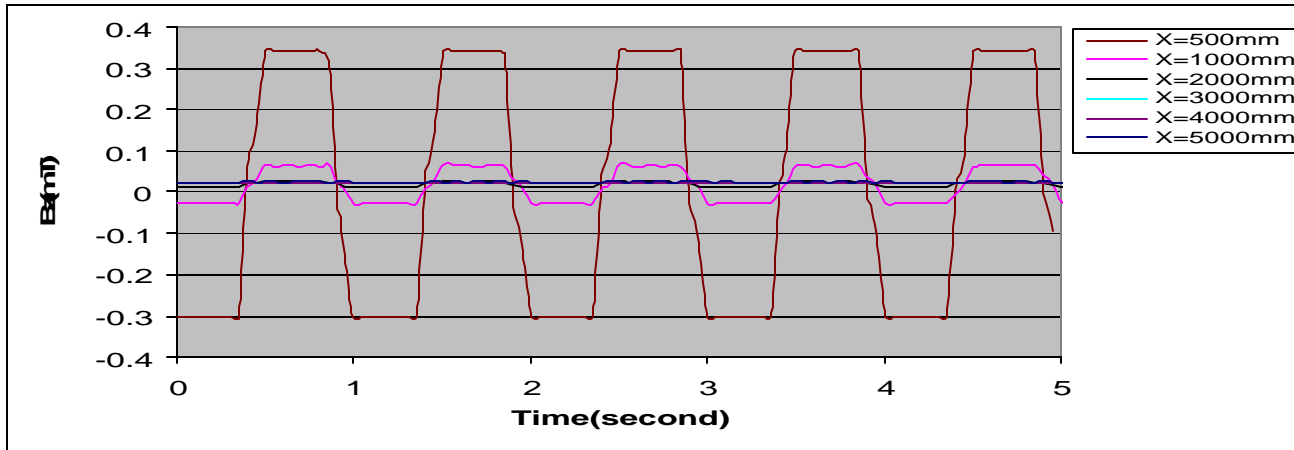
-Output Field vs. Frequency. Field limitation for approx sine wave field with +/-160V Bipolar Power Supply



GMW 5403AC: Laminated Magnet

-Fringe Field along X axis at +/- 1T center field

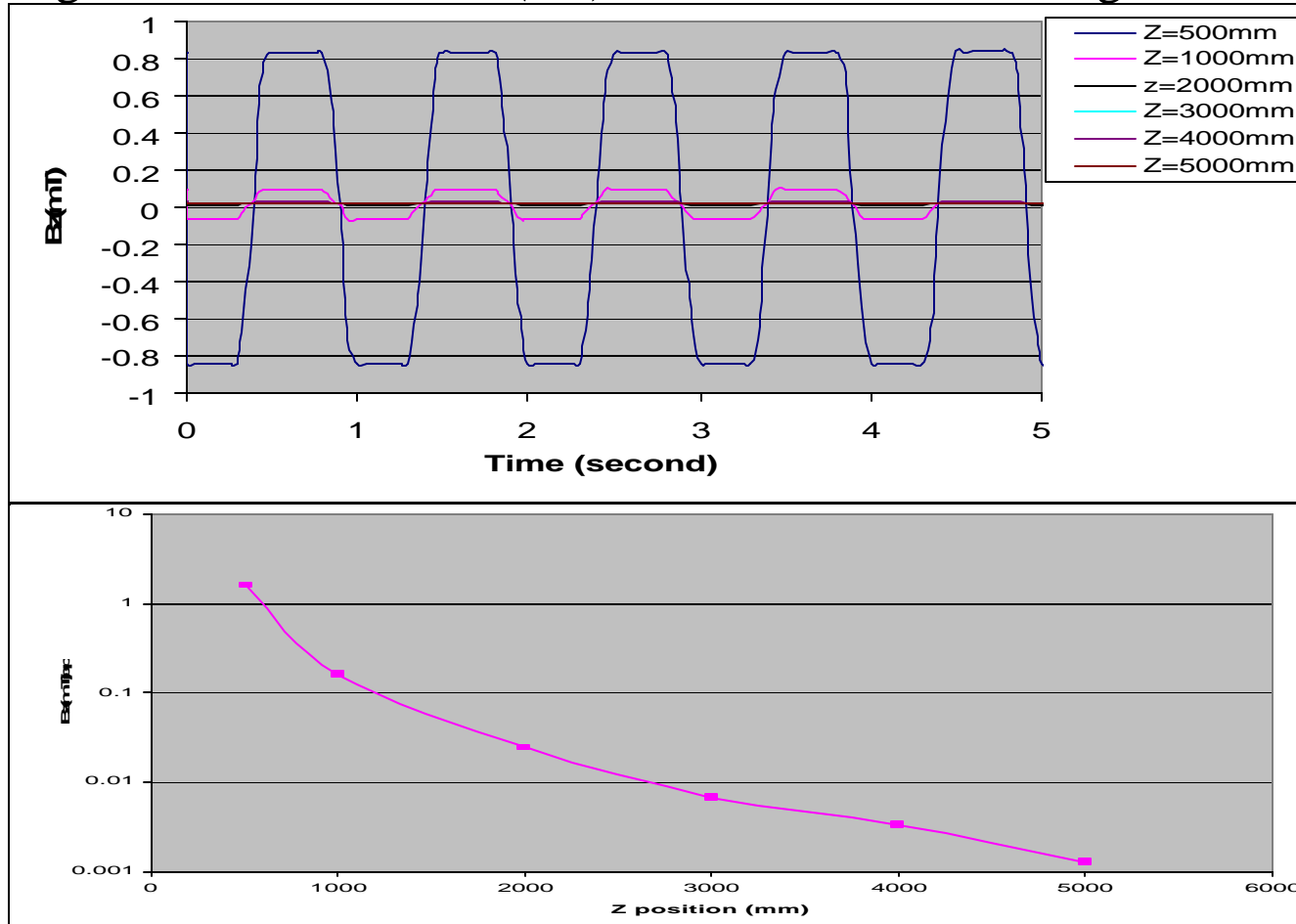
Fringe field max < 0.5mT(5G) at about 0.5m from magnet center.



GMW 5403AC: Laminated Magnet

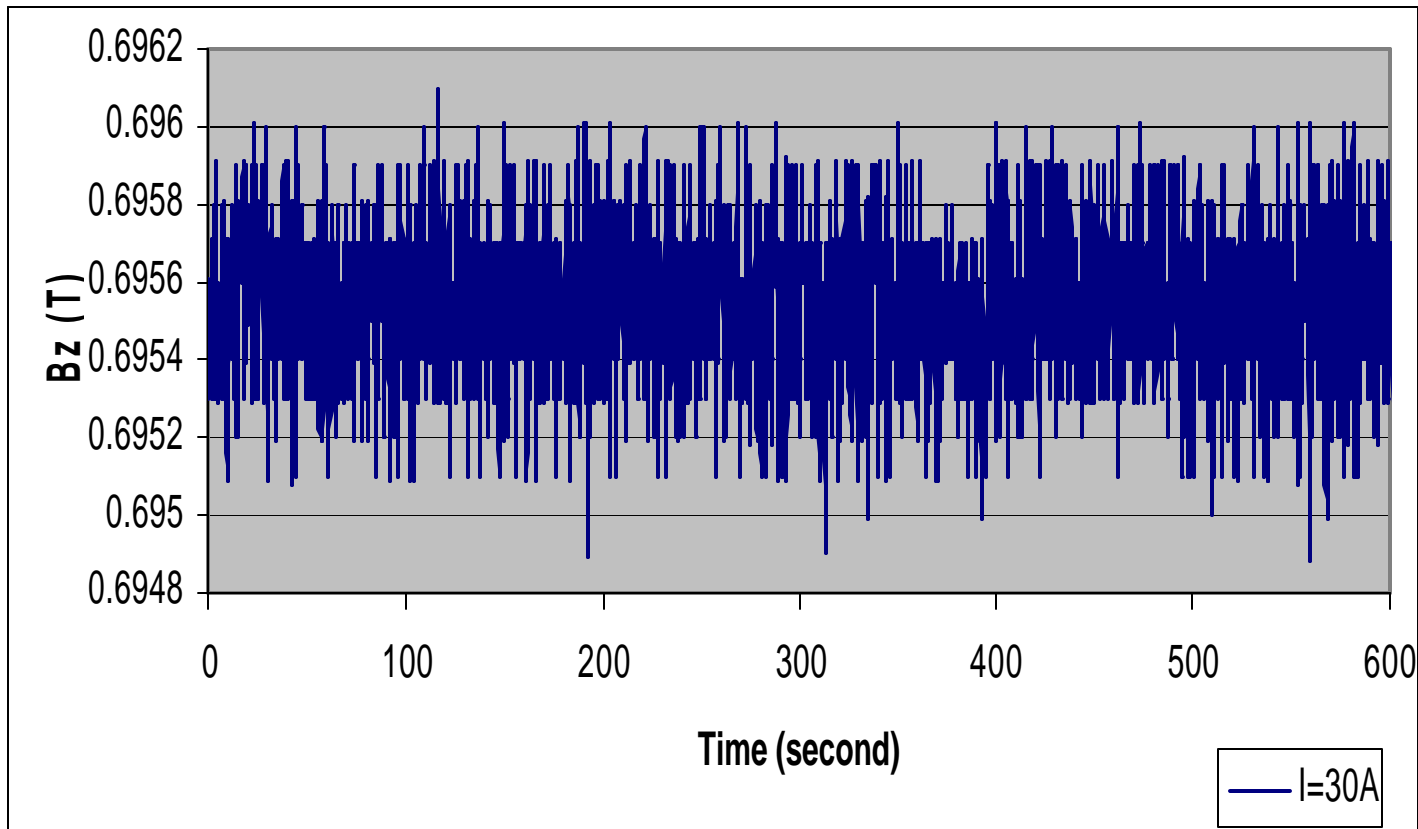
-Fringe Field along Z axis at +/- 1T center field

Fringe field max < 0.5mT(5G) at about 0.8m from magnet center.



GMW 5403AC: Laminated Magnet

-Field Noise and Stability



GMW 5403AC: Laminated Magnet

-Uniformity (32mmx32mm square pole face at 32mm Pole gap)

