Magnetic Field Compensation System *FAST* MR-3

Three axis automatic compensation of magnetic field disturbances from DC to $> 10 \text{ kHz}$

**Features**

- Continuous real time compensation of magnetic field disturbances from DC to above 10 kHz
- Typical 55 dB attenuation from DC to 200 Hz, 26 dB @ 9 kHz
- Magnetic field measurement with high resolution sensors
- Rugged analog design, no tedious programming
- Integrated power amplifiers for direct connection of compensation coils
- Field monitor and alarm functions

**Applications**

- Improvement of electron microscope images (SEM and TEM)
- Biomagnetic and paleomagnetic applications
- Compensation of power line frequencies (50/60 Hz) and harmonics
- Attenuation of slow or stepped magnetic field changes caused by vehicles, moved magnetic objects, elevators, etc.
- Attenuation of 9 kHz magnetic field from robotic wafer transports
Description

The magnetic field compensation system *FAST* MR-3 is a new version of our proven MR-3 system. Typical applications are noise reduction in electron microscopy, electron and ion beam experiments, magnetic resonance imaging (MRI), biomagnetic investigations, SQUID operation, and paleomagnetic research. **The frequency range has been increased to above 10 kHz to cancel high frequency noise from robotic wafer transport in modern semiconductor wafer fabs.**

The *FAST* MR-3 is a feedback compensation system. The magnetic field noise is reduced by establishing a compensating magnetic field in opposite direction. The *FAST* MR-3 continuously compensates magnetic field disturbances in the frequency range from DC to > 10 kHz. The magnetic field is measured with a low noise triaxial fluxgate magnetometer combined with a triaxial induction coil sensor. Analog control electronics generate compensation signals which are fed to the built-in power amplifiers for direct connection of compensation coils. Typically, such coils simply consist of a set of cable rings with a low number of wires installed in the edges of the laboratory.

![SEM image improvement](image1.png)  
**FAST MR-3 off**  
**FAST MR-3 on**

Specifications

- Magnetic field sensor: triaxial fluxgate sensor and triaxial induction coil sensor
- Zero drift: < 0.1 nT/K
- Noise: < 1 nT RMS (0.1 Hz < f < 10 kHz)
- Dynamic compensation range: > 6 µT<sub>PP</sub> (60 mG<sub>PP</sub>)
- Analog outputs: 1 V/µT, BNC connectors for X, Y, Z
- Bandwidth: 0 to 10 kHz (−3 dB)
- Digital displays: show incremental DC or true rms AC magnetic field for X, Y, and Z
- Resolution: 1 nT
- Measurement accuracy: ±1%
- Analog meters: show coil current, range ±3 A
- Attenuation DC to 200 Hz (*): typ. 55 dB
- Attenuation @ 9 kHz (*): typ. 26 dB

(*): at sensor position, for compensation coils with 2 m maximum side length.

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