

Magnetic Active Compensation System for Electron Microscopy

Features:

- **Uniform protection from environmental AC/DC magnetic interference over a wide frequency range**
- **Patented wideband negative-feedback design provides electronic magnetic compensation**
- **Offers protection against fluctuations in magnetic fields caused by:**
 - Subways
 - Electrical Distribution Equipment
 - Elevators
 - Moving Vehicles
- **Can be applied to existing or new installations**



The ETS-Lindgren[™] Magnetic Active Compensation System (MACS[™])

provides cost-effective, maintenance-free environmental magnetic field shielding solutions for high resolution EM (Electron Microscope) instrumentation. They are the highest-performance commercial magnetic field compensation equipment available for protecting sensitive EM instruments from AC/DC environmental magnetic fields. These reliable systems provide real time compensation of environmental magnetic field fluctuations caused by moving vehicles, trains, elevators, electrical distribution equipment and other sources.

ETS-Lindgren's MACS systems provide a uniform solution, at DC and through low frequency, using a highly sophisticated electronic magnetic compensation technology. Utilizing a patented wideband negative-feedback electronic design, the equipment deeply attenuates interfering magnetic fields at a fraction of the cost of alternative methods, such as passive shielding or relocation. Field attenuation

at the protected EM exceeds a factor of 30. This permits the successful operation of EMs — especially units with highly susceptible FEG emitters — at virtually any site.

Applications

MACS systems broaden siting possibilities by allowing EMs to be placed in locations where varying high magnetic fields are present. As a result, they can be installed at sites that have been previously rejected due to magnetic field interference.

Performance

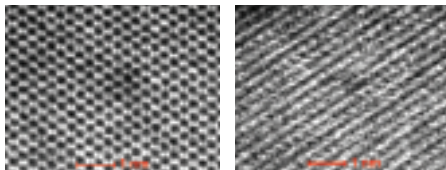
ETS-Lindgren's unique MACS-series active-feedback magnetic shielding technology* provides instantaneous, high-level protection at any frequency or combination of frequencies within a wide passband. No other commercially available compensation system attains this high level of magnetic field cancellation at all frequencies that can interfere with EM operation.

Highly sensitive proprietary** pickup sensors, mounted on the EM column, detect alternating current magnetic fields radiating from nearby AC power wiring, ground loops, transformers and related sources. The pickup sensors are physically small, yet highly responsive to interfering magnetic fields. Column-mounted AC sensors and the co-located preamplifier module assure maximum transverse field attenuation at the beam location. Extended-range MACS-QDC systems substitute a calibrated fluxgate probe to suppress lower-frequency magnetic field fluctuations caused by trucks, subway trains, and elevators or nearby analytical equipment such as mass spectrometers or MRI scanners.

High-level signals from the magnetic field sensor preamplifiers are conditioned and amplified by a phase-correcting signal processor and power driver in the controller chassis. Signal levels throughout the processing chain are supervised by an internal controller

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with front-panel programmable setpoints for axial tripoff. The controller also implements a setup algorithm for easy initial adjustment and provides continuous fail-safe fault monitoring for the internal power supplies and power amplifiers. Typically, the distortion known as astigmatism can be corrected by using variable electromagnetic compensation coils.



The image at left shows the silicon (110) lattice with resolution near the 1.4 Å requirement for observing “dumbbells” while the image at right shows distortion “banding” resulting from stray AC fields. Data courtesy of International SEMATECH.

To reduce interfering magnetic fields throughout the room, compensation flux is generated by driven coils that are mounted along or near the room vertices. Coil sets for each axis are placed on opposing walls and consist of single 0.5" (1.3 cm) o.d. cables installed in the plastic raceway. Cable installation is fast and noncritical.

Maintenance-Free Operation

MACS systems are designed to require no maintenance or adjustments following initial installation under normal operating conditions. Additionally, the system is designed for 24-hour operation and protection from environmental interference.

the support of the EM vendor. The system can be installed on new EM sites as an insurance against EM interference, or on existing sites that are experiencing unanticipated low frequency magnetic field interference. Coils are installed in a neat and inconspicuous manner, ensuring that room aesthetics are not compromised.

Warranty

ETS-Lindgren's standard limited warranty covers parts and service for one year.

* U.S. Patent 5,465,012

** U.S. Patent 5,469,05

System Installation

MACS systems may be installed and calibrated in as little as three days with

Specifications

Model EMFC-AC-3:

3 axis

2m³ minimum protected volume

32 dB (factor of 40) typical a.c.
— mains magnetic field attenuation

3 μ T_{avg} (30mG_{avg}) max. compensation

10Hz - 1.5 kHz bandwidth

1nT_{avg} (10 μ G_{avg}) noise floor

Model EMFC-QDC-3:

3 axis

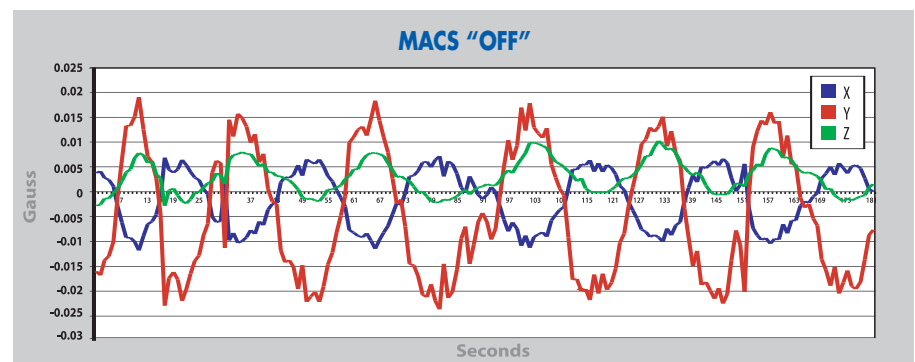
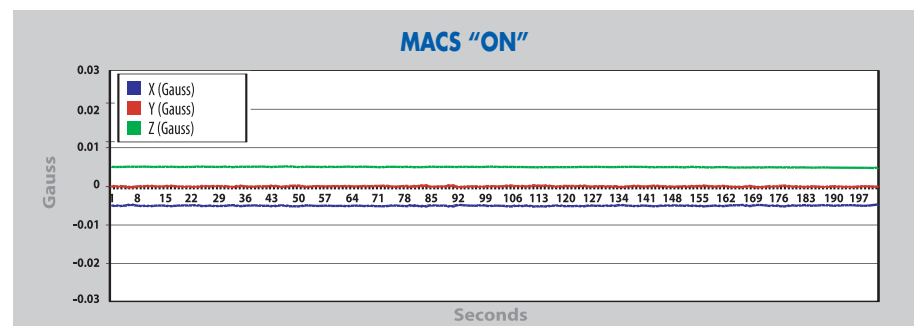
5m³ minimum protected volume

>30 dB (factor of 32) attenuation of magnetic field variation

3 μ T_{avg} (30mG_{avg}) max compensation

.001 Hz - 1.0 kHz bandwidth

1nT_{avg} (10 μ G_{avg}) noise floor



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