Scanning Magnetic Microscope

The Tristan model SMM-770 Scanning Magnetic Microscope is designed to measure magnetic fields above a planar surface with unparalleled spatial resolutions.

Using a liquid nitrogen SQUID sensor, it can be used to image room temperature objects such as:

- traces on a circuit board or multi-chip module
- shorts to ground planes
- current distributions
- magnetic inks used in currency

Magnetic image of dollar bill section

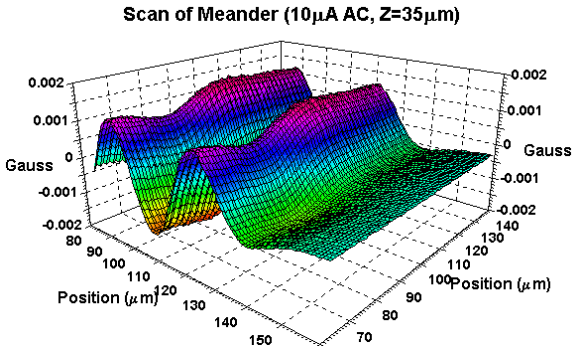
- insulators, ferrous and non-ferrous metals to detect cracks, voids and corrosion
- nanoparticle distributions
- flux-motion in HTS materials

The SMM-770 can also be configured to detect:

- induced magnetization
- magnetic susceptibility
- eddy currents
- magnetic hysteresis
- micropaleontology
- magnetobiologic activity

Model SMM-770 Scanning SQUID Microscope with dc and ac biasing magnets

- The SMM-770 is a fully featured measurement system that allows the user to extract a magnetic image of the object being measured over the entire dc – 10 kHz frequency range.
- Whether the samples are circuit boards, multi-chip modules, steel or aluminum plates, composites or even plastics, the SMM-770 can measure surface and even deeply embedded sources with a spatial resolution down to 50 µm.
- The use of a High Temperature Superconducting dc SQUID sensor gives it unparalleled sensitivity with the ability to measure fields smaller than 20 pT/√Hz. Tristan's HTS sensors can also operate in applied magnetic fields up to 1000 oersteds.
- The SMM-770 allows computer controlled scans of objects over a large (15 x 15 cm) area with 25 µm stepping capability with sub-micron stepping available. The user has the ability to preprogram the scan coordinates.
- The SMM-770 requires minimal setup. Automated setup and computer control makes measurements rapid and repeat-able. System software provides the ability to control the critical system components, acquire data from the SQUID sensor, and analyze the data to determine the magnetic properties of the sample being measured. The use of open architecture software allows the user to customize nearly all aspects of operating including image processing.



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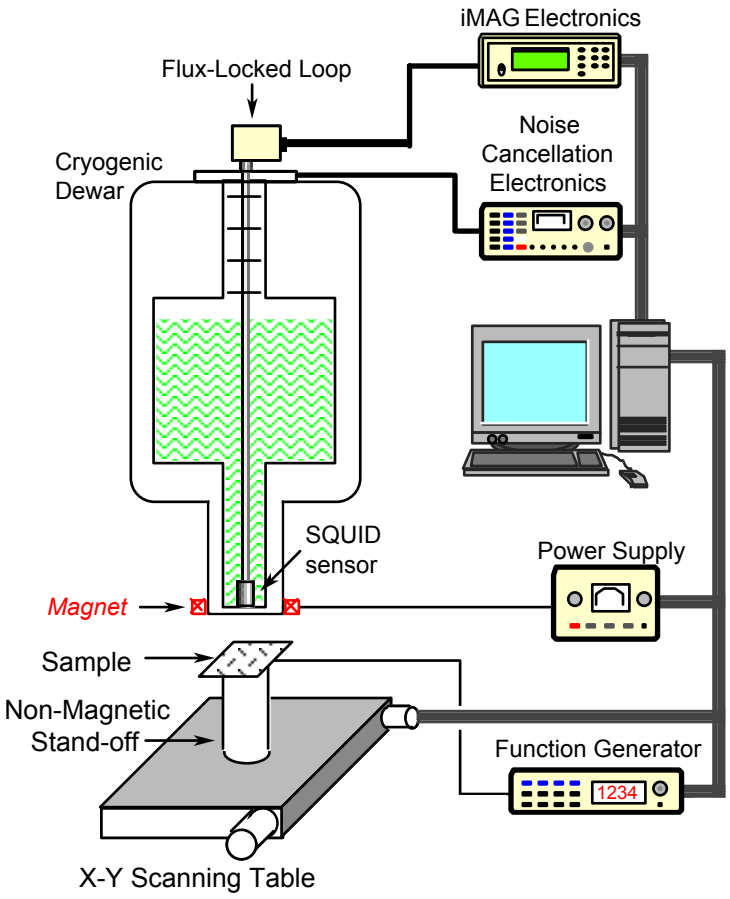


Components of the Model SMM-770 system including optional accessories

The standard SMM-770 is configured to detect magnetic fields generated by electric currents and to measure remnant magnetic fields. It includes a Single-Channel Scanning SQUID Magnetometer Probe, iMAG® SQUID Electronics, Cryogenic dewar, Room Temperature Scanning Stage, Computer Control and Data Acquisition System, and Imaging Software. The SMM-770 can be supplied with additional capabilities to extend its measurement capabilities.

OPTIONS AND ACCESSORIES

SCAN AREA: Larger scan areas (*e.g.*, 30 cm x 30 cm) and higher resolution stepping (25 µm standard) are available upon request.

Substitution OF HTM-1 SQUID Sensor: For measurements where sensitivities significantly below 20 pT/√Hz are needed and ultimate spatial resolution is not as important, Tristan can substitute the model HTM-1 sensor with a significantly larger (1 mm) detection coil with a sensitivity better than 3 pT/√Hz. The HTM-8 (8 mm coil) sensor with a sensitivity better than 0.05 pT/√Hz is also available.

Fixed Field Capability: This option consists of a fixed field that generates a vertical (B_z) field on the sample. This allows magnetic susceptibility measurements on insulators, conductors and ferrous materials to be performed. System noise is dependent upon field

ac Field Capability: This option allows a small vertical ac magnetic field (up to 1 kHz) to be imposed on the sample. This capability is of interest when eddy current measurements are desired. This option can be used simultaneously with the dc Field Option for added flexibility in magnetic characterization.

Horizontal Field (B_x and B_y) Sheet Inducer: A horizontal field sheet inducer, which can apply an ac magnetic field parallel to the test surface, to induce a large extended eddy current in a desired orientation, can be used to image cracks or material loss deep in conductive (*e.g.*, aluminum) structures.

ac Field Compensation Electronics: When imaging conductive materials, if an ac signal is directly coupled into the system, the resultant signal (from the field coils) may be much larger than the signal from the sample. To minimize this, Tristan can supply an ac Compensation system to null the ac signal in the detection coil and extract the induced signal in the object being measured.

Magnetic Shield: For situations where environmental noise is excessive, Tristan can supply the MS770 magnetic shield. This two layer µ-metal shield provides up to 50 dB attenuation of external noise/signals.

SPECIFICATIONS

SENSOR: High temperature superconducting quantum interference device (SQUID) operating at 77 K

SPATIAL RESOLUTION: Better than 50 µm

SENSITIVITY: 2 x 10^{-11} tesla/√Hz (20 pT/√Hz)

OPERATING BANDWIDTH: dc - 1 kHz. Measurements can be made at any frequency.

CRYOGENIC COOLING: To avoid low frequency noise below 200 Hz, the system uses liquid nitrogen to cool the sensor.

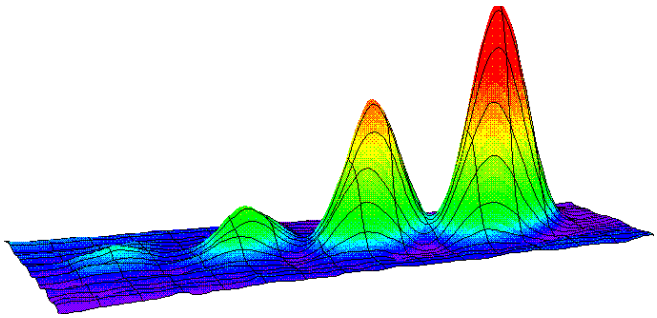
CRYOGENIC HOLD TIME: Time between refills of liquid nitrogen is typically 3 days

SAMPLE SCANNING RANGE: 15 cm x 15 cm in x-y directions

SCAN STEP SIZE: Adjustable with minimum step size of 25 µm.

SAMPLE PREPARATION: None required. Samples are measured at room temperature

POWER REQUIREMENTS: 100, 115 or 220 VAC, 50 or 60 Hz



Scan of 1, 3, 5, and 10 mm holes in a steel plate

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