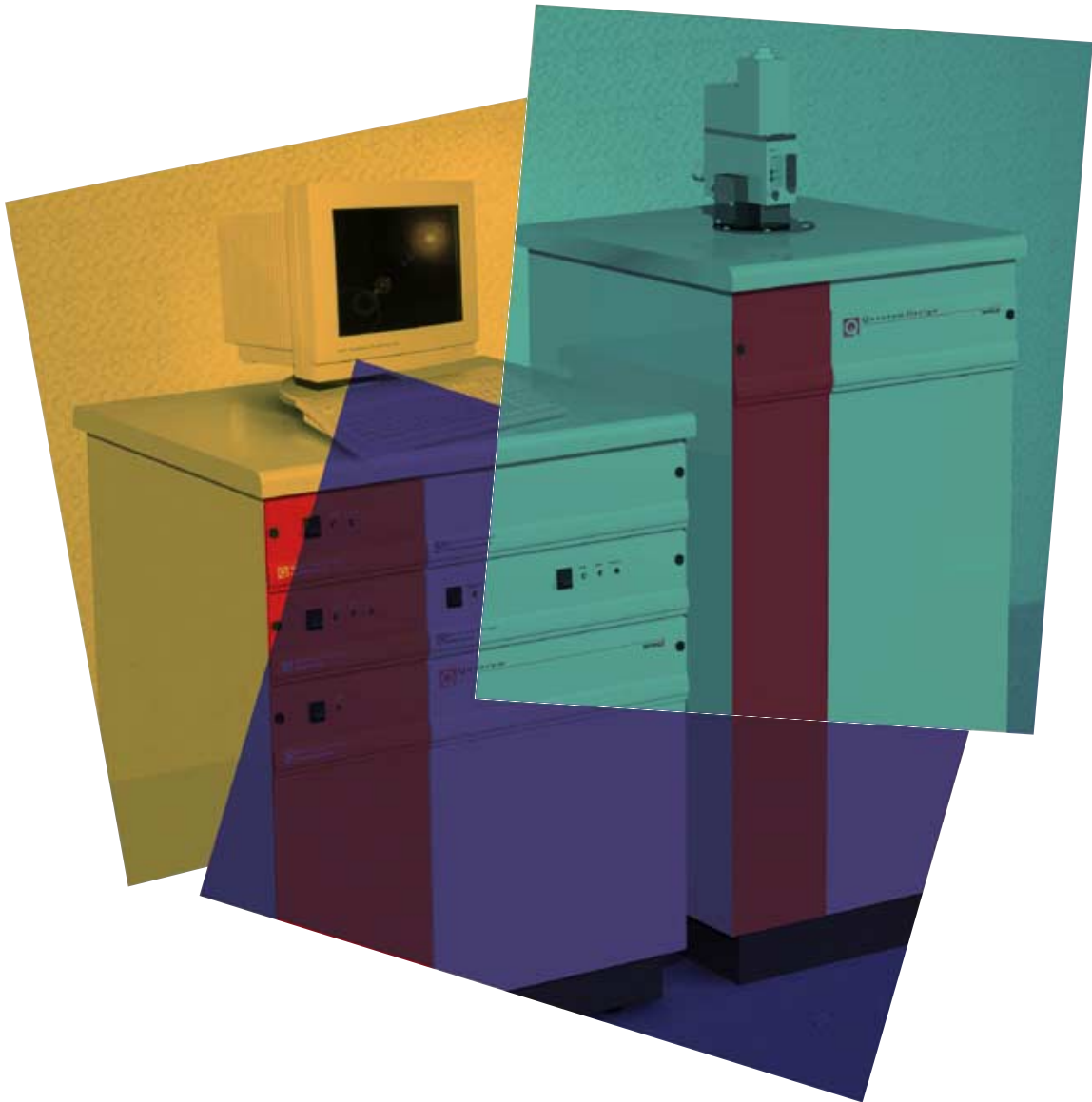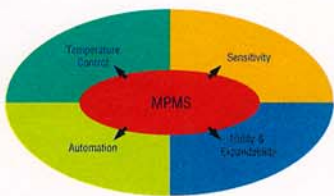# MPMS XL

Quantum Design

Magnetic Property Measurement Systems
MPMS *XL*

When introduced in 1984, the Magnetic Property Measurement System (MPMS) set a new standard for magnetometer instruments and magnetometry measurements. Today, with the introduction of the new *XL* series, Quantum Design's MPMS sets a new foundation for the instrument of tomorrow.

MPMS XL: using the highly successful MPMS as its platform, the new MPMS XL offers improved performance in all areas of magnetometry.

In response to the rising demands of today's magnetic researcher, Quantum Design has set a new level in SQUID magnetometry...the MPMS *XL*. From the automated software, dynamic range in temperature, sensitivity in measurement and user friendly architecture, the MPMS *XL* offers advanced performance in all areas of magnetometry. The combined capability of the new *XL* design with the proven capabilities and options of the MPMS systems, effectively takes SQUID magnetometry to a new level of research. With the *XL*, Quantum Design adds not only one or two extra functions, but sets a new foundation for the instrument of tomorrow.

MPMS *XL* Advanced Features
Improved Sensitivity

In addition to the traditional DC magnetization and existing SQUID-AC capability, the MPMS *XL* features the new *Reciprocating Sample* measurement system. This technique implements small amplitude, periodic displacement of a sample inside the MPMS' second order gradiometer. The movement of the sample results in an oscillating AC signal that is detected by the SQUID sensor. This technique combines the higher sensitivity of performing phase sensitive measurements with DC SQUID magnetometry to improve the overall sensitivity and noise rejection for DC magnetization measurements. With the Reciprocating Sample technique, sensitivities of 1×10^{-8} emu are now routinely available.

Extended Low Temperature Capability

The MPMS *XL* features significant improvements in the temperature control system. Utilizing a new patent-pending design for the helium flow impedance, the MPMS *XL* has the capability to operate continuously at temperatures below 4.2K for indefinite periods of time—completely removing time limitations for making measurements in this temperature regime.
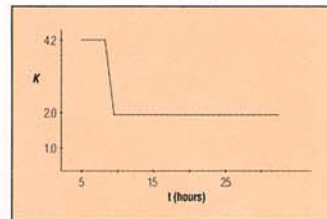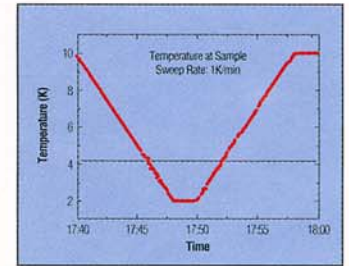

Improved low temperature operation in the MPMS XL ensures constant, stable temperatures below 4.2K.

The new MPMS *XL* eliminates the operations associated with filling and recycling the ^{4}He reservoir. Thus, the system solves the traditional problems of temperature instability and hysteresis associated with rapid boiloff of liquid helium when warming through 4.2K. The results are smooth monotonic transitions across 4.2K during both warming and cooling temperature sweeps. All these capabilities are fully automated for precise systems control and user
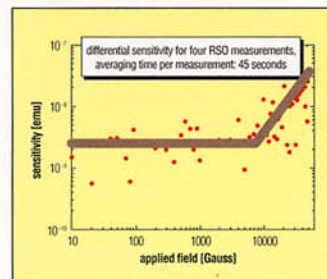
friendly operation. The user need not operate any valves, attach extra hardware or set up complex routines during a sequence.

The improved temperature control system in the MPMS XL ensures stable control of temperature through the 4.2K transition of helium.

Enhanced Thermometry and Temperature Sweep Operation

In addition to a redesigned impedance system, the MPMS *XL* uses a new thermometer design for improved temperature accuracy and precise thermal control. The new thermometry, designed and developed at Quantum Design, is installed in close proximity to the sample within the sensitive coil detection region. This improved design is combined with new temperature control capabilities to provide more accurate measurements of the sample chamber, even under extreme temperature changes.

The new *Temperature Sweep* mode of operation provides MPMS *XL* users with the ability to take magnetic measurements while sweeping the system temperature at a controlled rate—automatically—with no manual intervention. This mode provides a

The Reciprocating Sample technique offers sensitivities of 10^{-8} emu over a wide range of field strengths.

Specifications

controlled, monotonic change in temperature during a measurement sequence at rates up to 10K/minute. Measurements of temperature dependence over large temperature ranges, which previously required time consuming temperature stabilization, can now be made quickly and precisely using the Temperature Sweep Mode.

Software Control/Automation

A new software interface completes the flexibility and usability of the MPMS XL. Running under Microsoft Windows the state-of-the-art MPMS MultiVu software interface provides a level of control for system operation, graphics and data analysis previously unavailable. With MultiVu, simultaneously viewing data files in multiple formats is easily accomplished (e.g. a graph and a text file). Similarly, display of multiple graphs allows for easy comparison of results from different experiments. Operationally, MultiVu is a valuable tool in setting up and editing several measurement protocol files simultaneously.

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Reciprocating Sample Measurement System (M130)

Features:

- New servo powered, shaft-encoded transport allows precision oscillating sample motion
- New sample rod with low thermal expansion and radial sample centering features
- New high precision data acquisition electronics, including a digital signal processor
- New MPMS software revision, including support for all Reciprocating Sample Features:
  - SQUID signal analysis phase-locked to sample motion
  - support of longitudinal and transverse measurement axes
  - sample centering methods
  - support of all measurements with new sample transport (AC, DC, Reciprocating Sample)
- 16 measurement ranges from 10^{-5} emu to 5 emu
- Frequency range: 0.5 – 4.0 Hz
- Oscillation amplitude range: 0.5 to 50 mm p-p
- Max. DC scan length: 87mm
- Relative sensitivity: max. of <1 x 10^{-8} emu or 0.1% (0 – 2,500 Oe)
- *Upgrade available for all basic MPMS systems*

Continuous Low Temperature Control and Enhanced Thermometry (M140)

Features:

- New dual impedance design allows *continuous* operation below 4.2K
- New sample space thermometry improves temperature control

- Transition through 4.2K requires no ^{4}He reservoir refilling and recycling (no pot fill)
- New MPMS software revision for all Continuous Low Temperature features
- Minimum continuous operating temperature: 1.9K
- Operation below 4.2K: exceeded 45 hours during factory testing at 1.9K
- Temperature stability: $\pm0.5\%$ (1.9K – 4.2K)
- Includes Temperature Sweep feature (see below)
- *Upgrade available for all basic MPMS systems*

Temperature Sweep (M145)

Features:

- Includes new sample space thermometry (Enhanced Thermometry)
- Sweep rate range: 0.001 – 10K/min (data acquisition at slower sweep rates is recommended)

MPMS MultiVu Software

Features:

- Simultaneous access to all aspects of system operation: sequence setup, data analysis, data display
- Enables multiple documents and view to be visible and useable that the same time
- Simultaneous display of data files in multiple formats (e.g., graphs vs. text)
- MultiVu operates under Windows' with full Windows'-based mouse control for all operations
- Automated Background Subtraction
- Remote system operation and servicing via the internet
- *Upgrade available for all basic MPMS systems*

Configurations

The MPMS *XL* is offered in two high homogeneity magnet configurations-MPMS *XL*-5 (5 Tesla) and MPMS *XL*-7 (7 Tesla). Each system includes:

- Reciprocating Sample Measurement System
- Continuous Low Temperature Control/Temperature Sweep
- MPMS MultiVu Software Interface

Now MPMS *XL*-1 (1 Tesla) System also available.

Options

- Transverse Moment Detection
- Vertical Sample Rotator
- Horizontal Sample Rotator
- Sample Space Oven
- Magnet Reset
- Extended Dynamic Range
- External Device Control
- SQUID AC Susceptibility Measurement
- Ultra Low Field Capability
- Fiber Optic Sample Holder
- Low Field Profiling
- Manual Insertion Utility Probe
- Environmental Magnetic Shield
- Liquid Nitrogen Shielded Dewar