

## EV9 Vibrating Sample Magnetometer



Building on more than 25 years of experience, MicroSense (formerly known as ADE Technologies) Vibrating Sample Magnetometer systems (VSM) have become the standard at many university and industry research laboratories, as well as production facilities.

Virtually any type of magnetic material can be characterized on the EV VSM systems. Solids, liquids, powders, thin films, rocks etc. are all common applications for the EV VSM systems.

### GREAT LOW AND HIGH FIELD CAPABILITIES

The EV9 VSM is unique in its combination of a very high maximum field for a compact system combined with unrivaled low field measurement performance. The EV9 also offers the highest signal to noise ratio under most normal measurement circumstances.

Due to a proprietary real-time field control system, this system is suited for measuring samples with extremely low magnetic signals and/or very low coercivities. The EV9 is the most compact electromagnet based VSM that can reach a maximum field of 2.15T with the temperature option or vector coil option in place.

### VERSATILITY

The EV Series VSM supports all known types of magnetic measurements such as Hysteresis and minor loops, IRM and DCD Remanence Loops, SFD, Delta M, delta H and Henkel Plots, as well as Angular and AC Remanence Loops, Temperature scans and Time decay measurements. Also, the user has the option to custom create measurements with full control over system functions. Any series of measurements can be run without user intervention, using the flexible EasyVSM software.

### HIGHEST SENSITIVITY AT USABLE GAP

While other similar VSM systems boast their performance at sample spaces too small for practical use the EV9 system has the lowest noise at any gap, 0.5 micro-emu when used with LNA temperature chamber and below 0.1 micro-emu at a usable sample space of 5 mm. While at any gap the EV9 system offers an equal or higher SNR than its competitors, due to the large ID of the temperature chamber, the Signal to noise ratio with the temperature option is approximately 5 times better than in competing systems.

## BENEFITS OF USING THE EV9 VSM

- Noise below 0.5  $\mu\text{emu}$  when used with the EV1-LNA temperature option
- Noise below 0.1  $\mu\text{emu}$  at a usable sample space
- Field noise as low as 5 mOe
- Maximum field of 2.6 Tesla
- Highest magnetic field of 2.15 T with temperature chamber in place of any similarly sized system
- No hardware change between cooling and heating from 77 K to 1000 K
- Slide mounted oven/cryostat for quick change between room temperature and low/high temperatures
- New helium temperature option 4.2 K to 450 K
- Safe and reliable air-cooled magnet power supply

### HIGH ACCURACY

The high precision real time, direct field control used in conjunction with high performance signal acquisition and processing, leads to increased accuracy of the measured graphs and measured parameters, while at the same time facilitating measurements on soft magnetic samples with field resolution of 1 mOe. The EV9 VSM system offers a dynamic field resolution whereby the field resolution switches, during the measurement, to the best available for the given field range. This is critical when measuring low coercivity materials after setting a higher initial field to saturate.

### FLEXIBLE OPTIONS: THREE SYSTEMS IN ONE

ALL EV VSMs offer a unique combination system including torque, and/or magneto-resistance (MR) options, which can be added to the VSM without increasing the system footprint and are less expensive than buying separate systems.

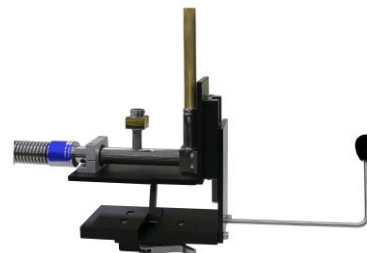
The torque option measures the torque of materials as a function of rotation angle and applied field, resulting in Anisotropy data. The MR measures the resistance of thin film samples as a function of magnetic field, temperature, and angle. Measurements (with > 5000 points) take less than two minutes.

### FAST AND EASY TO USE

A unique sample vibrating mechanism makes sample mounting and alignment fast and convenient. Samples can quickly and easily be aligned properly to maximize the measurement accuracy and repeatability. Thanks to the direct field control and high sensitivity the EV9 is typically 3 times faster than competing systems.

The temperature options (Helium temperature chamber shown here) always remain installed on the system and can be moved in and out of place using a simple lever-slide mechanism.

This allows very fast changes between room temperature and low or high temperature measurements.



# EV9 Vibrating Sample Magnetometer - Specifications

## MAGNETIC FIELD

### Maximum Field

With sample space of 5 mm:	2.6 T
With sample space of 10 mm:	2.4 T
With oven/cryostat:	2.15 T
With Vector Option:	2.15 T
With Torque Option (with VSM coils in place)	2.4 T
With Torque Option (with VSM coils removed)	2.8 T

### Field Resolution and Noise

Range	Resolution	Noise
32 Gs	0.001 Gs	15 mGs/5 mGs*
320 Gs	0.01 Gs	15 mGs/5 mGs*
3.2 kGs	0.1 Gs	50 mGs/5 mGs*
32 kGs	1 Gs	100 mGs/15 mGs*

\*When used with optional low noise field probe

## MAGNETIC MOMENT

Dynamic range	0.1 $\mu$ emu – 100 emu (extendable to 1000 emu)		
Signal ranges	1, 2, 5, 10, 20 .... $\mu$ emu – 1000 emu		
Accuracy	$\pm$ 1% + noise if sample and calibration standard are equal in shape and size.		
Repeatability	$\pm$ 0.5% + noise (Typical: 0.1%) at constant room temperature		
Drift	0.05% RMS of full scale Measured over 48 hours at constant field and room temperature		
Noise (0.1 s T.C.)	5 mm sample space	10 mm sample space	with EV1-LNA
1 avg.	1 $\mu$ emu	1.5 $\mu$ emu	2.5 $\mu$ emu
30 avg.	0.5 $\mu$ emu	1 $\mu$ emu	1.5 $\mu$ emu
100 avg.	0.1 $\mu$ emu	0.3 $\mu$ emu	0.5 $\mu$ emu

## Options

### EV1 – VAR AUTOMATIC ROTATION

Range:	$\pm$ 400°
Resolution:	0.002°
Accuracy:	$\pm$ 0.2°

### EV1 – LNA TEMPERATURE CONTROL

All MicroSense VSMs uniquely offer continuous range temperature control from liquid nitrogen to 1000K, without any changes in hardware.

Switching measurements from room temperature to low or high temperature occurs within seconds thanks to the slide mounted temperature chamber.

Due to a unique all-quartz temperature chamber design with a large ID, the noise with the temperature control system in place is approximately 2 times lower than the noise of any competing system and the achievable signal to Noise Ratio (SNR) is approximately 5 times better.

Range:	77 K, 100 K-1000 K
Resolution:	0.01 K
Inside diameter:	10 mm

### EV1-LHE TEMPERATURE CONTROL

Liquid Helium temperature control system, can be used with liquid nitrogen with optional N2DEW system. This system offers high resolution temperature control with minimal impact on the system noise and background

signals. Thanks to the low noise and large ID, the SNR with this option is at least 3 times better than the SNR of similar competing systems.

Range:	4.2 K + 8 K – 450 K
Resolution:	0.01 K
Inside diameter:	9 mm

### EV1-HT TEMPERATURE CONTROL

Argon High temperature system	
Range:	300 K – 1273 K
Resolution:	0.01 K
Inside diameter:	10 mm

### EV1 – SCV VECTOR COILS

For simultaneous detection of X and Y Vector components of the magnetic signal.

Maximum field: 2.15 T

### EV1-TRQ TORQUE MAGNETOMETER

Unique add on option for very accurate and sensitive real torque measurements.

The picture to the right shows the EV9 with the torque magnetometer and VSM vibrator mounted. (The torque transducer is placed over the center of the magnet). The torque transducer and vibrator head are mounted on a slide for quick and easy switching between torque and VSM measurements. A true torque magnetometer is much more accurate and more than 5x more sensitive than a vector coil based torque system.



Range:	1 to 400 dyne-cm full-scale
Resolution:	0.0025% of full scale range
Accuracy:	1% when calibrated with pure Ni standard
Noise:	0.05 dyne-cm RMS (without averaging) 0.005 dyne-cm RMS (30 Averages)
Maximum field:	2.8 T with pickup coils removed

(For optimal torque noise performance a vibration free environment is required)

### EV1- MR MAGNETO RESISTANCE OPTION

Allows the measurement of MR samples as a function of field, temperature, field angle and sample current.

Measurement time: Adjustable from <10 seconds up.

Typical measurement time: 1 or 2 minutes with 3000-3600 data points per minute

Ohms range:	<1mOhm to >1MOhm
Ohms accuracy:	1%
Ohms repeatability:	0.1%
Resolution:	16 bit
Temperature range:	-150 °C – 400 °C
Current ranges	$\pm$ 2 mA, $\pm$ 20 mA
Current resolution:	<0.1 $\mu$ A

Specifications are subject to change at any time without notice.

For more information on MicroSense VSM systems please visit <http://www.microsense.net/products-vsm.htm>

01-15-2010