Temperature Options for the EV series of VSMs

MicroSense currently offers 3 different temperature options for the Vibrating Sample Magnetometers:

- EV1-LNA (77K + 100K-1000K)
- EV1-HE (4.2K, 6K-450K)

All these temperature systems have the following features in common:

- Minimum impact on the system noise and background signal
- Preserve as much as possible of the system maximum field.
- Easy to use, easy to switch between room temperature and temperature operation
- Large sample space, resulting in 7.5 times higher signal to noise ratio
- Fast temperature changes and measurements

Minimum impact on noise and background signal

The temperature chamber is insulated by a double wall of non-magnetic material, which ensures that the sample signal is not disturbed. Also, the temperature chamber does not significantly increase the noise level for most applications, resulting in a noise level that is up to 3 times lower than what is achieved by many competitors.

High Magnetic Field

The small OD of the sample temperature chamber, allows for a relatively small spacing between the magnet pole faces, leading to a high maximum field with the temperature chamber in place.

Ease of Use

All MicroSense EV-VSMs have the unique slide mounted temperature chamber (see figure 1) that facilitates quick changes between room temperature and low or high temperature measurements. The temperature option always remains installed on the measurement station with all tubes etc. attached. This means that when you want to do a measurement at temperature, nothing needs to be installed or changed, you just flip a lever and the temperature chamber slides in place.

Also, all temperature systems except for the EV1-HE and the EV1-Cryocool system, require no vacuum pump system. The EV1-HE system requires only occasional pumping of the transfer line for best system performance.

Figure 1. The temperature chamber is mounted on a slide that allows the user to bring the chamber in place in seconds when needed and move it out of the way easily to quickly change samples.

Large Sample Space

Our temperature chambers have an inner diameter of 10 mm (EV1-LNA and EV1-AR), 9 mm (EV1-HE), and 7.74 mm (EV1-Cryocool) allowing for larger sample sizes (and better SNR) than possible with some competing systems.

Because of the larger sample space, you will have a larger signal. If we assume a horizontally mounted round sample with a 1 mm clearance around the sample, the 10 mm sample chamber can accommodate a sample of $0.25*\Pi*8^2$ mm^2 = 50.26 mm^2. For comparison, a 7.1 mm chamber can accommodate a 20.4 mm^2 sample and the 6 mm ID chamber a 12.56 mm^2 sample.

This means that with the EV1-LNA you can have more than 2.5 times as much signal compared to some other ovens or cryostats on the market.

Virtually no impact on the system noise.

The temperature options have been designed to have virtually no impact on the system noise performance and the system noise at the gap between the coils that is required for the temperature options is a factor two lower than in competing systems. As a result, most of our customers never feel the need to adjust the coil gap to reduce the noise further. The noise in our most common VSM systems is below 2.5 micro-emu with the temperature option in place, without any signal averaging. For complete specifications, please see the tables below.

Fast Temperature changes and fast measurements

The temperature chamber can be ramped up and down in temperature at high speed (typically 60-100 K/min, depending on the temperature chamber and temperature range). This will minimize measurement time. Additionally, given the 7.5 times higher Signal to Noise Ratio, 60x less averaging is needed** so that measurements on low signal samples can be much faster.

A brief description of the different options:

EV1-LNA

The EV1-LNA is our most common and most cost effective temperature option with a temperature range of 77K to 1000 K. The sample is placed in a double wall, platinum coated, quartz temperature chamber. The quartz material ensures that the sample signal is not influenced by the presence of the temperature chamber. The sample is placed in an inert Argon gas atmosphere for high temperature measurements (room temperature to 1000K) or in a nitrogen atmosphere for low temperatures (77K to 600K). It is even possible to use regular compressed air for above room temperature measurements to 600K if oxidation of your sample is not an issue.

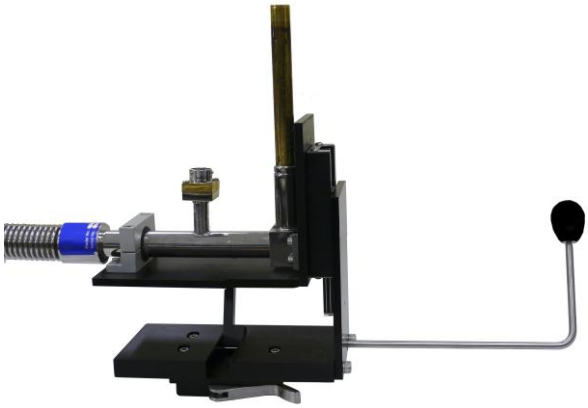
The large 10 mm ID of the temperature chamber allows larger samples than possible in most competing systems and this large ID also makes it easier to do angle dependent measurements without the risk of having the sample touch the walls of the temperature chamber. The EV1-LNA system is supplied with a 25 liter liquid nitrogen Dewar.

EV1-HT

The EV1-HT option uses a vacuum insulated double wall and a high power heater to allow temperatures up to 1273K in an Argon environment.

EV1-HE

The EV1-HE uses a proprietary alloy double wall insulation for the temperature chamber. This alloy ensures that the sample signal is not influenced by the presence of the temperature chamber. The temperature range available with this option is 4.2K + 6K to 450K.



EV1-LHE temperature chamber shown in the up position on the vertical slide

The large 9 mm ID of the temperature chamber allows larger samples than possible in most competing systems and this large ID also makes it easier to do angle dependent measurements without the risk of having the sample touch the walls of the temperature chamber.

The EV1-LHE cryostat is mounted on a vertical slide, making it easy to move the cryostat down and out of the way when it is not needed or up and around the sample when you want to perform a low temperature measurement. The whole assembly uses one quick connect clamp to mount the cryostat in the system or to remove it and replace it with the EV1-LNA option.

Because of the high quality vacuum insulation and materials used, the system walls don't need to be pumped before every measurement (as is common in some other systems). This further adds to the ease of use of this cryostat.

N2 DEW

The N2 DEW option includes a 50 liter liquid Nitrogen Dewar and an adaptor to use this Dewar with the EV1-LHE option. Also included are a rolling base for the Dewar and a power supply and heater element to slowly boil-off the liquid nitrogen to provide pressure and gas for the cryostat.

Liquid Nitrogen Dewar

Specifications

Temperature System	Temperature range	Sensor	Gas	ID (sample space)
EV1-LNA	77K + 100K to 600K 300K to 1000K	E-Type TC	Nitrogen Argon	10 mm
EV1-HT	300K to 1000K	K Type TC	Argon	10 mm
EV1-HE	4.2K + 6K - 450K 85K – 450 K	GaAs Diode	Helium Nitrogen	9 mm

VSM System	Max. Field with EV1-LNA	Noise without averaging (with EV1-LNA)	Noise with 100 avg. (with EV1-LNA)	Noise without averaging (with EV1-HE)	Noise with 100 avg. (with EV1-HE)
EV7	1.75T	2.5	0.5	5.0	1.0
EV9	2.15 T	2.5	0.5	5.0	1.0
EV11	2.7 T	5 (<3 Typical)	0.5	10 (5 typical)	1.0

Temperature Range	System	Gas	Resolution
300K- 1273 K	EV1-HT	Argon	0.01
77K + 100K-600K	EV1-LNA	Liquid N2 + N2	0.01
300K-600K	EV1-LNA	Nitrogen or Argon	0.01
300K-1000K	EV1-LNA	Argon	0.01

Temperature Range	System	Gas	Resolution	Stability (St. Dev.)
4.2K, 6K-450K	EV1-HE	Liquid Helium	0.001	0.2 (0.1 typical
85K – 450K	EV1-HE	Liquid Nitrogen, using N2DEW	0.001	0.2

All specifications are subject to change without notice.

For more information about the MicroSense series of Vibrating sample magnetometers visit

http://www.microsense.net/products-vsm.htm