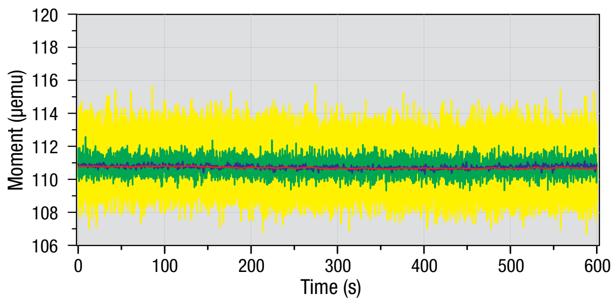
APPLICATION BRIEF



Typical Noise Performance for Samples Measured in 8600 Series VSM with Single-Stage Variable Temperature (SSVT) Option

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Among the temperature options for the 8600 Series, the 86-SSVT is the most versatile because it covers the largest temperature range and offers the lowest moment measurement noise.

The moment noise is directly proportional to the electromagnet (EM) gap. The VSM detection coils are attached to the face of the electromagnet poles and increasing the EM gap places the detectors further away from the sample. The signal-to-noise ratio (SNR) for the VSM decreases as the distance between the detection coils and the sample increases. This results in an increase in noise for the same given signal level.

In the case of the SSVT, the electromagnet gap Index 3 is 16 mm. The sample space (option ID) of the SSVT is 6.4 mm in diameter.

For this measurement we chose a suitably low moment sample — a trace amount of grade C1 ceramic magnet. The sample was chosen to have a magnetic moment that was small enough to demonstrate different noise levels for different measurement averaging times. At the same time, the moment is large enough to produce a still usable measurement with the shortest average time. Presenting the data this way, we hope to give users a better understanding of averaging time and noise as this influences actual measurements.

These measurements were performed with 86-SSVT installed and maintaining 295 K in the sample space. The sample was placed in the flow of nitrogen gas. As positioned inside the SSVT sample space, the sample rod/holder does not touch the inner wall of the SSVT. Because the sample vibrates, any such contact will raise the measurement noise significantly and must be avoided.

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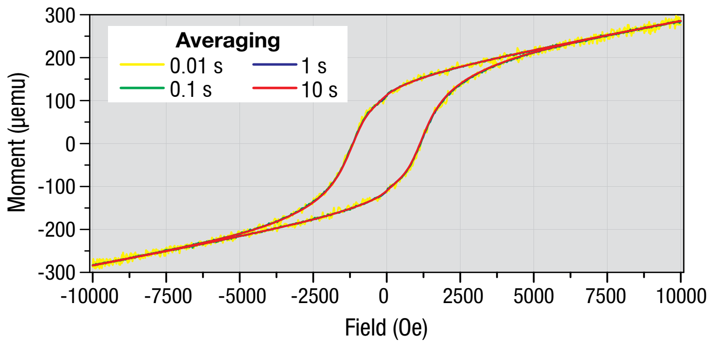

Figure 1: *Hysteresis curve (M vs. H) recorded at different averaging times.*

In order to emphasize the difference between the four averaging times, let's look closer at a small segment of the curve presented in Figure 1. We chose only the descending branch of the same hysteresis measurement, between 6 kOe and 4 kOe.

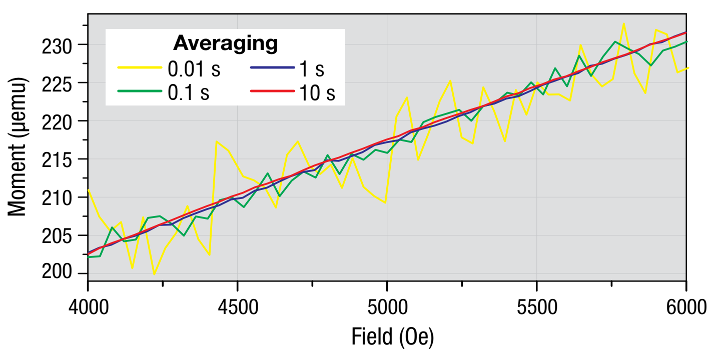

Figure 2: *Segment of hysteresis, chosen along the linear portion of the loop, for clarity.*

In the case of the VSM, the vibration isolation between the head drive and the electromagnet poles/detection coils is critical in lowering the coherent pick-up. Briefly, a detection coil "sees" the opposite pole and slight non-uniformity in field as they vibrate. Minute amounts of vibration traveling from the head drive to the electromagnet, on the order of a few microns, could translate into a coherent pick-up signal on the order of microemu. Because this vibration is the same as the actual sample vibration, this signal can't be rejected by the VSM's lock-in amplifier. This and other background factors add to the measurement noise. When used in technical literature, this is often simply called "noise."

The Model 8600 has a fixed time constant of 0.01 s, and the test was performed at four different averaging times: 0.01 s, 0.1 s, 1 s, and 10 s.

Considering the above, we performed static field, moment vs. time measurements in two typical conditions: 0 applied field and 5 kOe applied field.

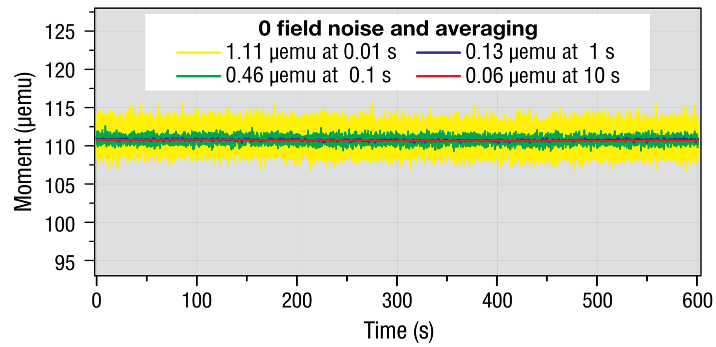

Figure 3: *Static applied zero field noise measurement. The noise values are calculated as standard deviation over a 10 min measurement.*

When the field is 0, the coherent pick-up is minimal because the electromagnet's poles are not being "seen" by the detection coils. In this case the noise is predominantly electric noise in the measurement system.

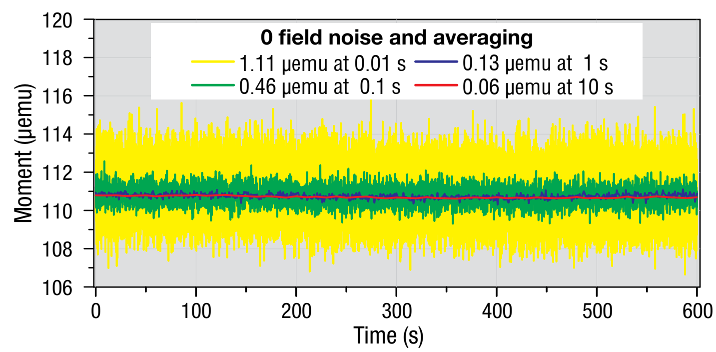

Figure 4: *Detail view of noise comparison as recorded under zero applied field.*

With an applied field, which is typically chosen to be 5 kOe, the coherent pick-up becomes significant, and the noise is larger overall.

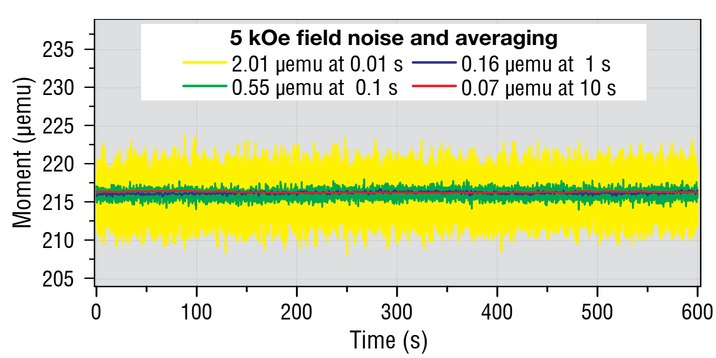

Figure 5: *Static applied field 5 kOe noise measurement. The noise values are calculated as standard deviation over a 10 min measurement.*

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