



VSM Application Note 1096-302

**Measuring Temperature-Dependent Magnetization with the PPMS Vibrating Sample Magnetometer (VSM)**

A primary source of noise and background signal in the PPMS Vibrating Sample Magnetometer (VSM) is microphonic signal pickup by the VSM detection coilset. The pickup mechanism is the motion of the sample chamber (and thus also the VSM coilset puck) in the large and slightly inhomogeneous magnetic field of the PPMS magnet. This background signal ( $V$ ) is generated by the time-changing net flux  $\Phi$  that threads the coils:  $V = -d\Phi/dt$ . Note that in fields of several tesla, a very small field inhomogeneity can easily produce a signal above the nanovolt noise floor of the instrument.

When the temperature in the PPMS is slewed, differential thermal contraction of the warm sample chamber and cold (4 K) parts of the probe causes occasional acoustic impulses that are heard as “tinking” or “popping” by the VSM puck when a large (greater than 1 T) field is applied. These impulses, which can appear as spikes in the magnetic moment data, primarily occur when temperatures are below 200 K. However, as shown in Figure 1, the acoustic noise subsides within two minutes after temperature stability is declared. (Sig X and Sig Y are the in-phase and quadrature components of the magnetic moment, respectively.) Therefore, users can prevent the noise in their data by waiting to take measurements until the temperature has been stable for two minutes.

Described below is a model sequence that steps in temperature and performs three single VSM measurements at each stable temperature. Note that a touchdown is performed before measurements at each new temperature in order to recenter the sample in the coilset.

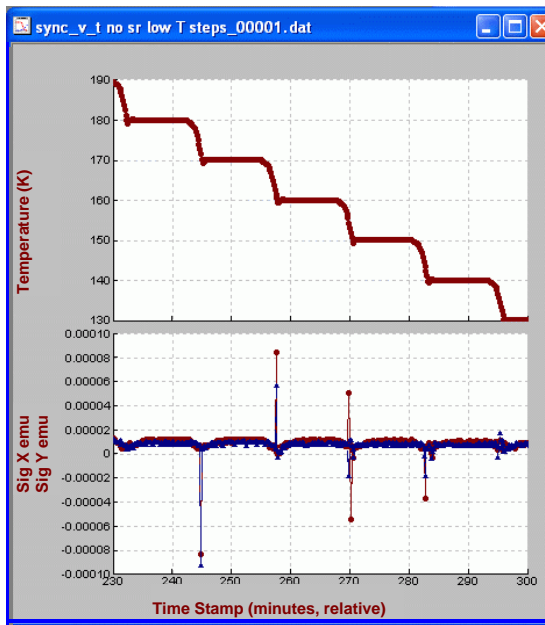


Figure 1. Temperature change and microphonic pickup of acoustic impulses by the VSM detection coilset

**SEQUENCE MODEL: M(T) STEPPED**

(Field = 9 T)

Scan Temperature from 300 K to 5 K in 5 K increments, 12 K/min, Fast settle

Wait 120 sec

VSM locate by touchdown

VSM single measure

VSM single measure

VSM single measure

End Scan