



MPMS3 Application Note 1500-024

Measuring a Hysteresis Loop with the ULF Option

The Ultra-Low Field (ULF) Option for the MPMS3 repurposes the same modulation and trim coils utilized for AC measurements to allow the user to accurately null the remanent magnetic field within a given ± 5 Oe setpoint. This is primarily used for field cooling and zero field cooling samples in small well-determined magnetic fields. However, with the use of a script (.bas file) a hysteresis loop can be measured using the VSM mode over a ± 20 -25 Oe range. This Application Note describes how to use this capability.

It is necessary to be running the latest version of MultiVu, release 2.3.4.15 or later. To upgrade to the latest version of MultiVu please contact your local service representative.

Step 1: Download the *ULF MvsH.bas* file from *Pharos*

Download the *ULF MvsH.bas* and *LoopLayout.bmp* file from the *Pharos* online digital database under *Customer Area/MPMS3/Measurement App Notes/ULF MvsH*

Save the folder *ULF MvsH* within the *C:\QdSquidVsm\Macros* directory in a dedicated folder, e.g. **ULF MvsH**, see Figure 1 below.

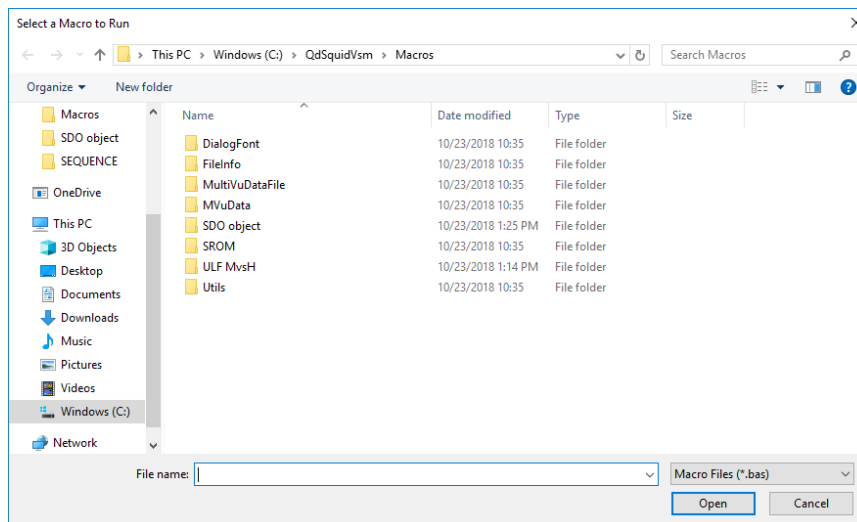


Figure 1. Save the *ULF MvsH.bas* file in a dedicated folder within the *C:\QdSquidVsm\Macros* directory.

Step 2: Complete the standard ULF Wizard to null the existing remanent field

In order to compensate for the remanent field of the superconducting solenoid use the standard procedure as outlined in the ULF option manual (1505-550) to null the magnetic field to 0 Oe.

Step 3: Install your sample

Using the conventional *Sample Install Wizard* install and center your sample. However, if performing a centering scan, when warned and prompted to set a centering field, as shown below in Figure 2, choose **No**. If the superconducting solenoid is energized the field nulling performed in Step 2 will be compromised. If the sample does not have a strong enough signal to center at zero field, then simply manually center the sample, ideally at 66 mm from the bottom of the sample holder.

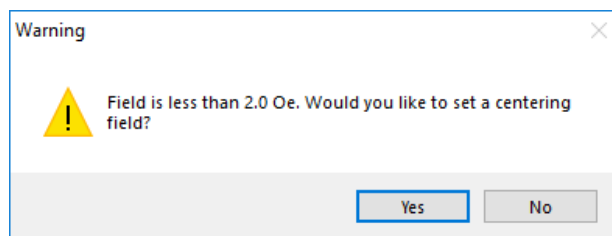




Figure 2. Make sure to choose **No** centering field during the *Sample Install Wizard*.

Step 4: Run the *ULF MvsH.bas* script

From the menu bar select *Sequence*→*Advanced*→*Edit Macro* which will open the MultiVu Scripting window. To open the *ULF MvsH.bas* file simply click the Open button  and navigate to the file location in the *QdSquidVsm/Macros/ULF MvsH* directory. To run the macro simply click the play button . This will then bring up the main **ULF MvsH VSM Measurement Setup** window, shown below in Figure 3.

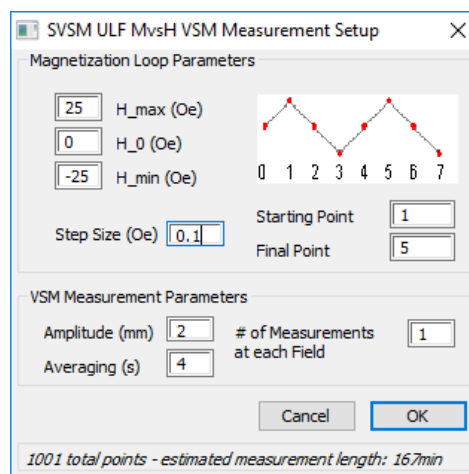


Figure 3. The ULF MvsH Measurement Setup window allows one to define the measurement parameters. Note, only VSM measurement mode is allowed.

Step 5: Enter the measurement parameters and click **OK**

The format of the *ULF MvsH VSM Measurement* window mimics the conventional *Moment vs. Field* functionality found as a standard sequence command.

A full 7-segment hysteresis loop can be measured, or only a specified portion. For example, in Figure 3 above a conventional major hysteresis loop (segments 1-5) spanning ± 25 Oe will be measured, using a step size of 0.1 Oe. Finally, the VSM measurement amplitude and averaging time can also be entered. Once the measurement parameters are specified, the measurement will commence after clicking the **OK** button. The resulting data will be saved to the *.dat* file specified during Step 3.

Additional Comments:

- (1) The compensation field will be continuously applied until reset by running the wizard or until set to zero by:
 - (i) Setting system into standby
 - (ii) Shutting down MultiVu
 - (iii) Manually shutting the current drivers down: Utilities→Ultra Low Field→Current Driver Shutdown
 - (iv) Using the sequence command: Measurement Commands→ULF→Shutdown Drivers
 - (v) Energizing the main superconducting magnet with a normal *Set Field* command

- (2) The *ULF MvsH.bas* script will only work with VSM measurement mode, and not DC scans. Note, the ULF option is only able to null the field within a ± 10 mm window, larger than the 8 mm maximum VSM vibration amplitude. A typical 30 mm DC scan would scan the sample outside of the uniform field window, and hence a DC scan is not recommended.

For questions contact apps@qdusa.com