

## Physical Property Measurement System (PPMS) – General Instructions & Info

All users must receive training for the PPMS and for whichever specific options they wish to use. Reserve all necessary time in Coral and enable and disable when starting and finishing your experiment. Fill out a log sheet for each use.

This document contains general system information and control instructions. The PPMS Hardware manual and the individual option manuals contain more detailed information. Please refer to the specific option SOPs for information on changing options/samples and making measurements. Please consult the manuals and/or the facility staff for help and troubleshooting information.

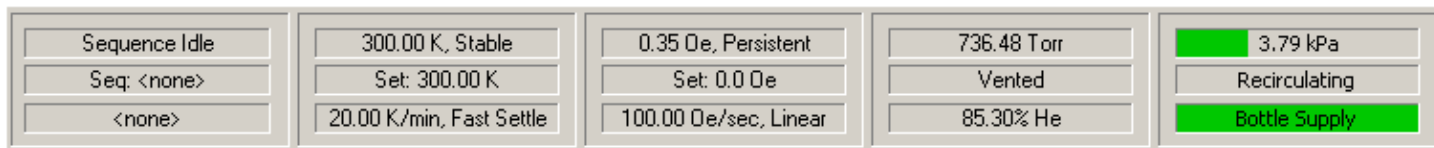
### Model 6000 Controller

This control unit sits in the PPMS cabinet and is the main controller for general hardware operations. While system controls are generally performed via the MultiVu software, all hardware control operations can also be performed using the Model 6000. This is primarily useful if the computer/software crashes or is unavailable for any reason. In some cases, changing options requires interchanging cable connectors on the back of the Model 6000 (see specific option SOPs).

### MultiVu

#### Main hardware controls

PPMS MultiVu is the main interface system for all hardware and measurement controls. The bottom of the window (see below) contains the main hardware system indicators, which can be used to access their respective controls by clicking the appropriate area. From right to left:



- **EverCool** – Indicates the status of the EverCool II helium compression/circulation system. The normal status is shown above. When compression is required (usually during magnet ramps and briefly during chamber purging), the pressure indicated on the top line will rise and that bar will expand and change from green to yellow. The system will also become significantly louder during this time. Users will generally not need to control the EverCool system. In some cases, it may be desirable to disable the cold head rotation in order to reduce the noise level on high-sensitivity measurements; consult facility staff if you think this will be necessary.
- **Chamber** – Indicates the sample chamber pressure, the gas control state, and the helium level. Normal operating pressure is 10 – 15 torr (helium). Control buttons include *Seal* (seal off chamber from pump and gas inlets), *Purge/Seal* (chamber is purged with helium gas and pumped three times, then sealed), *Vent/Seal* (chamber is purged with helium gas, then sealed), *Pump Cont.* (chamber is pumped continuously), and *Vent Cont.* (chamber is continuously flooded with helium).
- **Magnet** – Indicates the magnetic field and state of the magnet, the field setpoint, field ramp rate and approach mode. Control fields include: Setpoint (-90,000 to 90,000 in Oe where 1 T = 10,000 Oe), Rate (0 to 178 Oe/sec), Approach (Linear/No O’shoot/Oscillate – see manual for definitions), and Mode (Persistent/Driven). The normal operating state is Persistent, meaning a current (or no current for 0 field) is flowing through the superconducting electromagnet without any driving voltage. When the field is changed, a switch is activated (the state briefly reads “SW Warm”), a voltage is applied to change the drive current and thus the field (the changing field is indicated along with “Ramping”), then when the field is reached, the switch is opened (“SW Cool”) and the field

stabilizes. Under Driven mode, the switch always remains closed. This allows for faster changing between fields, but uses significantly more helium due to ohmic heating of the active switch. Do not apply a magnetic field if the helium level is below 60%.

- **Temperature** – Indicates the system temperature and control state, the temperature setpoint, and the ramp rate and approach mode. Control fields include Setpoint (1.9 to 400 K), Rate (0 to 20 K/min), and Mode (Fast Settle/No O'shoot – see manual for definitions). Note that the software will accept ramp rates up to 20 K/min to be input, but the system will likely not actually ramp this fast. Actual maximum ramp rates depend on the option being used and the temperature range. The temperature should not be immediately changed from high temperatures to < 10 K. In such cases, set the temperature to 10-15 K, wait for 15-20 minutes, then continue to the lower temperature. This practice should also be used within sequences.
- **Sequence** – See below.

### Data and sequences

While hardware operations can be controlled directly through the Model 6000, MultiVu is required for saving data and running automated sequences. In general, data from any measurement option can be saved for immediate measurements (these are generally handled through the option control windows – see option SOPs for details) or for measurements as part of a sequence. In general, the user has to specify to have data from immediate measurements saved, and data from measurements in sequences is automatically saved. Data is saved in .dat files, which are comma-delimited text files that can be imported into any standard analysis program. Opening a .dat file within MultiVu (this can be done in the main software window, or by clicking the `View` button within the data file area of the active option control window) will open a graph by default. Right clicking brings up a menu which includes Data Selection for changing the data axes and ranges (multiple Y axes are available) and Table View for viewing the data in table form. Once a file has been opened as a graph, MultiVu also creates an additional file with .gph appended to the file name; this file automatically saves the graph with the most recent data and axes.

Sequences are sets of control and measurement commands which can be used to run automated experiments. They are saved as .seq files, which appear in MultiVu as a simple series of command lines. The right side of the MultiVu screen is the menu of sequence commands. Double-clicking any item will add that command to the sequence above the line in the sequence which is highlighted. Double-clicking on a line within a sequence allows the command parameters to be edited. All the operations listed at the top of this page and many more are available. Commonly-used commands include temperature and field scans, during which measurements can be taken at specified intervals. The list of available measurement commands depends on the active option, and generally needs to be expanded by clicking “+” next to the option name. After writing a sequence, it must be saved, at which point clicking `Run` on the left side of the screen or the “play” button on the top toolbar will start the sequence. The current sequence status is given in the bottom (see above) and left sections of the screen. Some notes on sequences:

- Individual or multiple (using Ctrl-click or Shift-click) lines can be selected and cut, copied, pasted, or deleted.
- Right-clicking a selected line or set of lines allows it to be disabled, so it can be excluded from a running of the sequence without being permanently deleted from it.
- All temperature and field scans will automatically have an “End scan” line at the end. Any lines within the scan will be indented and will be executed at each point within the scan.
- Within a temperature scan, Sweep is a third Mode in addition to Fast Settle and No Overshoot. In this mode, measurements are made as the specified temperature is reached, and the temperature continues sweeping without ever settling. This is useful for very fast measurements (most electrical measurements), but is not recommended for measurements that take any appreciable amount of time (most magnetic measurements).
- At the end of all sequences, set the system temperature to 300 K and the magnetic field to zero Oe (persistent).