

## Set and Readback Test of Oxford Instruments Mercury Intelligent Power Supply

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This note presents the results of the set and readback measurements performed on the Oxford Instruments Mercury Intelligent Power Supply (iPS), which is to be used for the HDice experiment.

The Oxford Instruments Mercury iPS, Fig. 1, is a stable and bi-polar power supply, with a current precision specified to be better than 0.003%. The supply, which has features such as protecting against quench events, is designed to power superconducting magnets in laboratory applications.



FIG. 1. Oxford Instruments Mercury iPS power supply, configured with master shown on bottom and one slave on top.

For the test, the power supply was configured with a serial peripheral interface (SPI), master–slave connected via RS-485 serial communication, Fig. 2. The master unit has a single male RS-485 connector on the rear panel. The slave unit has two rear connectors, a female and a male, allowing the addition of another slave, if needed. The master unit was connected to the computer controller through a rear USB port. Ethernet and RS-232 also are available for communication.

Current outputs of the units were connected in parallel using a welding cable (1/0GA 600 V) and were covered for safety. The current range for the master–slave configuration is  $-120$ – $120$  A ( $-60$ – $60$  A and  $-10$ – $0$  V for each unit).

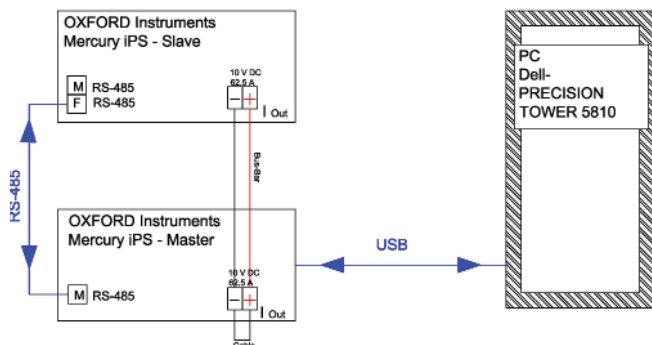


FIG. 2. Schematic of rear panels displaying the connections between master-slave Mercury iPS power supply units and computer.

Drivers used in the Mercury iPS software were written in LabVIEW 2015. All drivers use LabVIEW’s Virtual Instrument Software Architecture (VISA) components, allowing for communication between the Mercury iPS and the computer to set and read back parameters. All drivers open a VISA interface to the Mercury iPS, send specific text commands to set or read back a parameter, write to or read from the Mercury iPS, and finally, the VISA interface is closed.

These drivers were used in the LabVIEW program to generate current by the Mercury iPS, measure that current by the same Mercury iPS, and record the measured value. The user defines the maximum current up to 120 A, step size value, and ramp rate to run the set and readback current test.

The program begins by reading the value of the Mercury iPS current, checking if the value is 0 A, and setting the supply to 0 A if it is not. Using the “I set” subVI, a current is then generated equal to that set by the user. Using the “ramp status” subVI, the Mercury iPS goes to set mode, and then the first actual value is read using the “I-read” subVI. The set and readback values of the current are recorded in a text file. The value of the current is increased by the step size defined by the user, and the procedure is repeated until the final value of the range is tested.

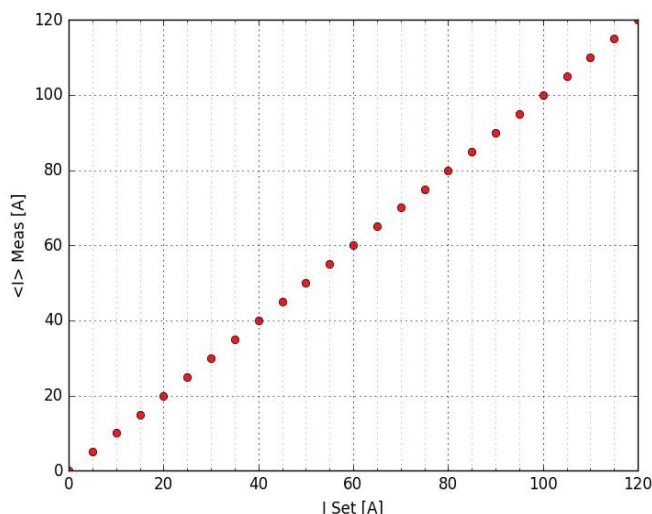


FIG. 4. Plot of set current vs. mean measured current for the final calibration test.

In the test, a ramp rate of 100 A/min and a range of 0–120 A were used to take 1,000 measurements at each 5 A step, totaling 25,000 measurements. To stabilize the current, at each step, the dwell time was set to 4 s. The mean and the standard deviation for each of 25 measurements were computed, entered into a spreadsheet, and plotted, Fig. 4.

The  $\langle I_{\text{meas}} \rangle$  error defined to be  $(|I_{\text{set}} - \langle I_{\text{meas}} \rangle|) / I_{\text{set}} * 100$  is calculated with the mean measured current values.  $I_{\text{set}}$  vs. error (in percent) is plotted in Fig 5.

The results indicate that the Mercury iPS is precise and stable down to 5 A, with the precision better than 0.003% all the way down to 5 A. The power supply functions as specified over the measured range.

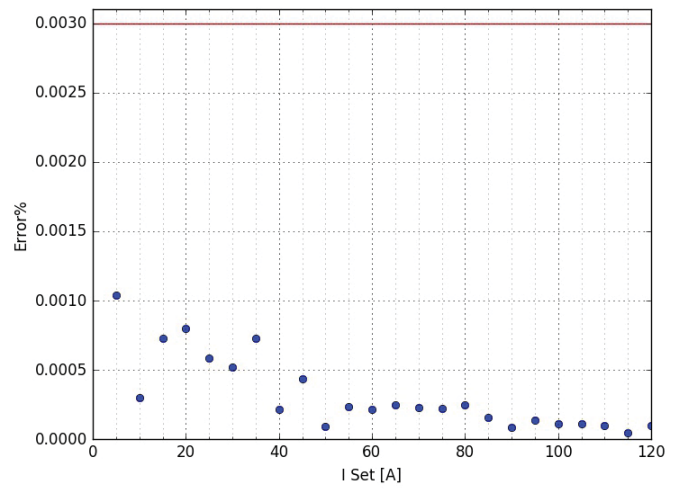


FIG. 5. Plot of set current vs. measured current error of the final test.