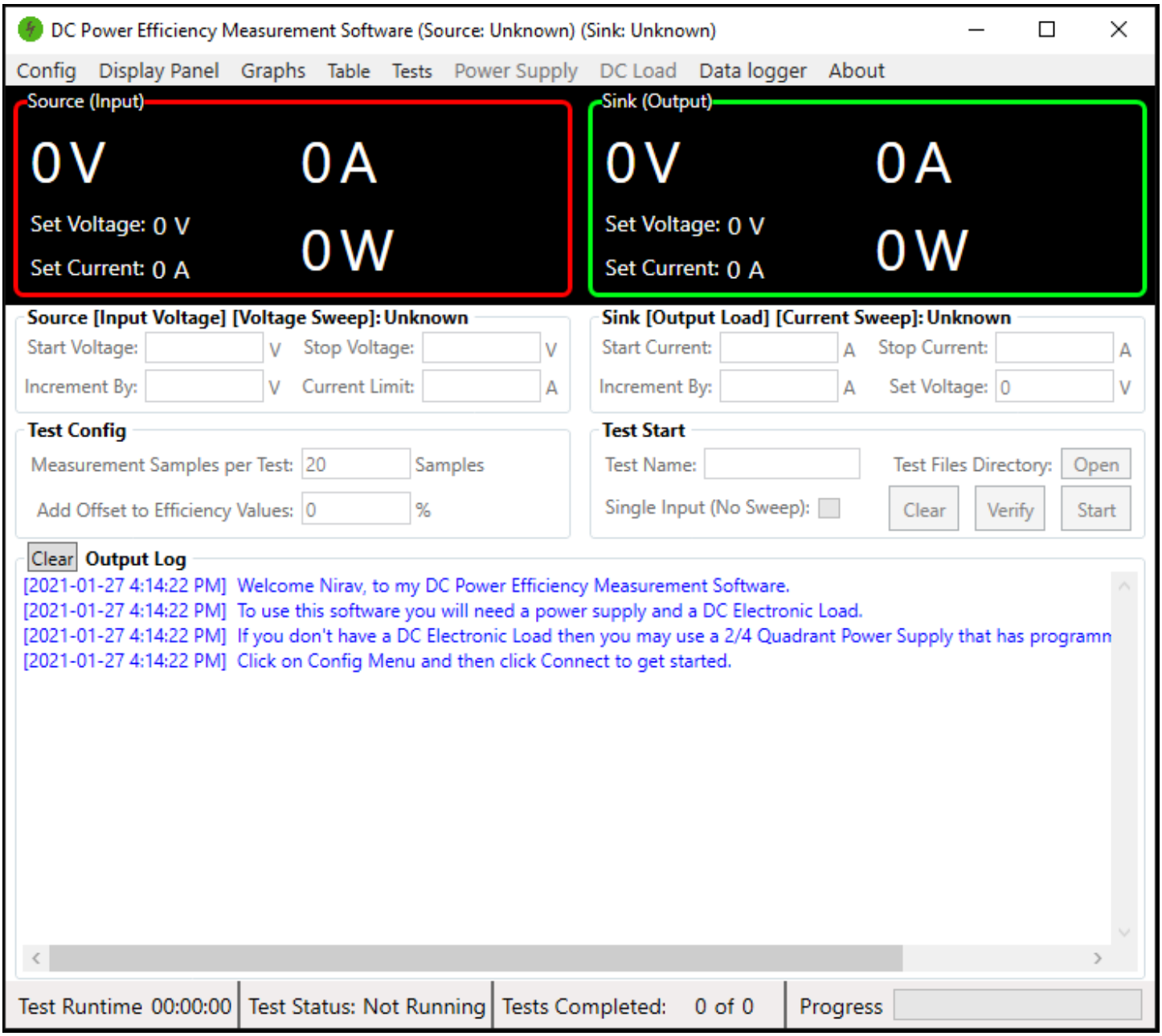
DC Power Efficiency Measurement Software User Manual

Supports most Programmable Power Supplies and DC Electronic Loads

Also supports 2/4 Quadrant Power Supplies (must have programmable sink capability)
Must connect instruments through serial interface.



Created by Nirav Patel
Supports Windows 10, 7, 8, & 8.1

Table of Contents

Theory of Operation

This software utilizes two instruments, one is a power supply to set the input voltage and the other is an electronic load to set the output load current. The power supply connects to the input terminals of your circuit. The power supply must operate in constant voltage mode and thus its current limit must be set appropriately. The dc electronic load connects to the output terminals of your dc circuit. The dc electronic load must operate in constant current mode.

The instruments must be connected through a serial interface. This software does not support any other type of interface. The accuracy of the software results depends on the accuracy of your instruments.

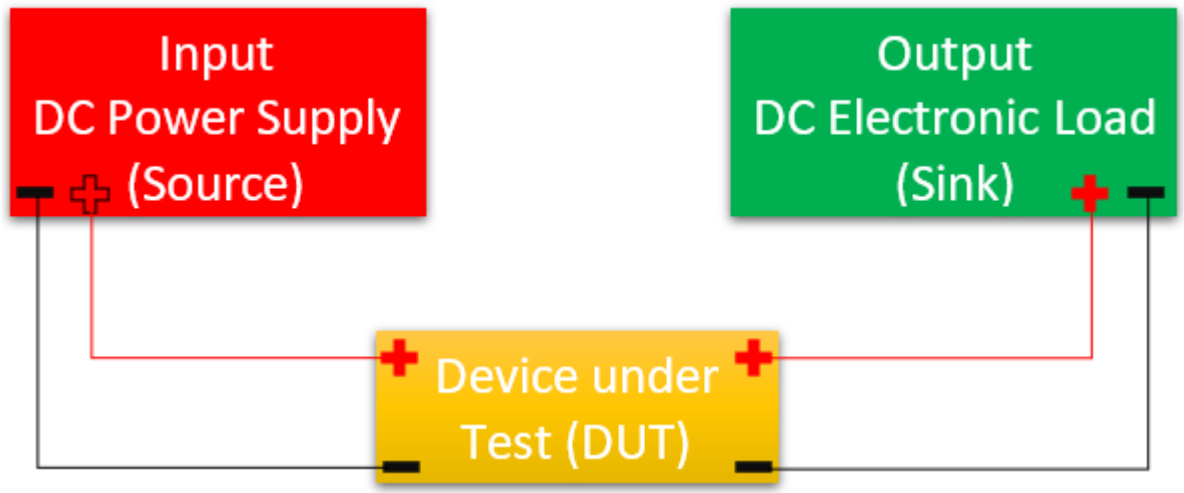


Figure 1: Test fixture. Connect your power supply to the input terminals of your device. And connect your dc electronic load and or 2/4 quadrant power supply to the output terminals of your circuit. The power supply will provide power to your circuit and measure voltage and current on the input terminals of the device. The dc electronic load will consume power from your device, as well as measure voltage and current on the output terminal of your device.

How the software calculates power efficiency among other stuff

The software only gets the measured voltage and current data from your power supply and dc electronic load. It uses this data to calculate input power (W), output power (W), power efficiency (%), power loss (%), input resistance (Ω), output resistance (Ω), and circuit resistance (Ω).

$$Efficieny\ (\%) = \eta = \frac{Power\ out\ (W)}{Power\ in\ (W)} * 100$$

$$Power\ out\ (W) = \big(Output\ voltage\ (V)\big) * (Output\ current\ (A))$$

$$Power\ in\ (W) = \big(Input\ voltage\ (V)\big) * (Input\ current\ (A))$$

$$Input\ Resistance\ (\Omega) = \frac{Input\ voltage\ (V)}{Input\ current\ (A)}$$

$$Output\ Resistance\ (\Omega) = \frac{Output\ voltage\ (V)}{Output\ current\ (A)}$$

$$Circuit\ Resistance\ (\Omega) = Input\ Resistance\ (\Omega) - \ Output\ Resistance\ (\Omega)$$

$$Power\ loss\ (\%) = 100\% - \ Power\ Efficiency\ (\%), assume \max\ efficiency\ is\ 100\%$$

Figure 2: The above equations are used by the software.

Software Loops

The core of the software is nothing but a three for loop, each one is within another one. The first loop is for setting input voltage on the power supply. The second loop is for setting the output load current on your dc electronic load. The third loop is about measuring voltage and current on the input and output side of your device.

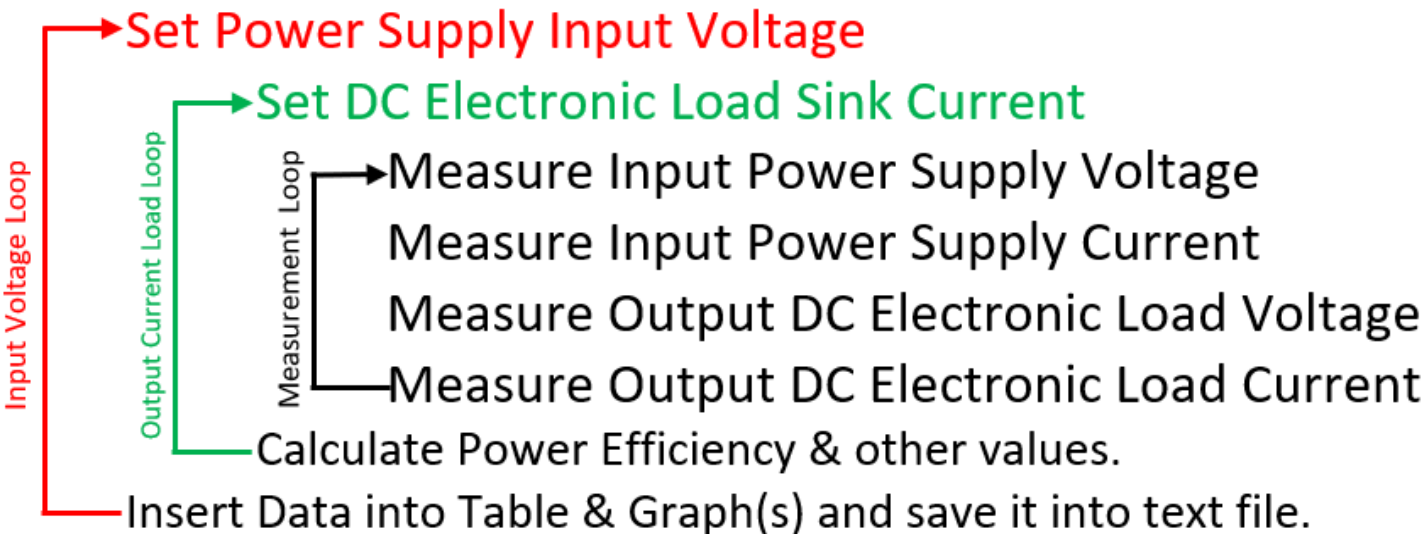


Figure 3: The Software loop for calculating power efficiency (%) for multiple input voltages and output current load values.

The input voltage loop depends on start voltage, stop voltage and voltage increment values. The output current loop depends on start current, stop current and increment current values. The final loop is your measurement loop, this loop depends on measurement samples. The total tests depend on how many input voltages you want to test your device's power efficiency for. Please keep in mind the maximum input voltages the software can handle is 50. The set input voltage loop can only loop 50 times. The set sink current loop determines how many load current values you want your device to be tested for, per input voltage value. The measurement loop runs for each set sink current value.

1 measurement sample = 4 measurements (2 for power supply + 2 for dc electronic load)

The maximum measurement samples the software can handle for total input voltage loops is 50000. That is 50000 * 4 = 200000 measurements read from power supply and dc electronic load.

Of course, you should never reach these limits, the software would have to do a lot of computational processing and your computer might not handle it, and the software might crash. A total of 20 input voltage values per complete software loop.

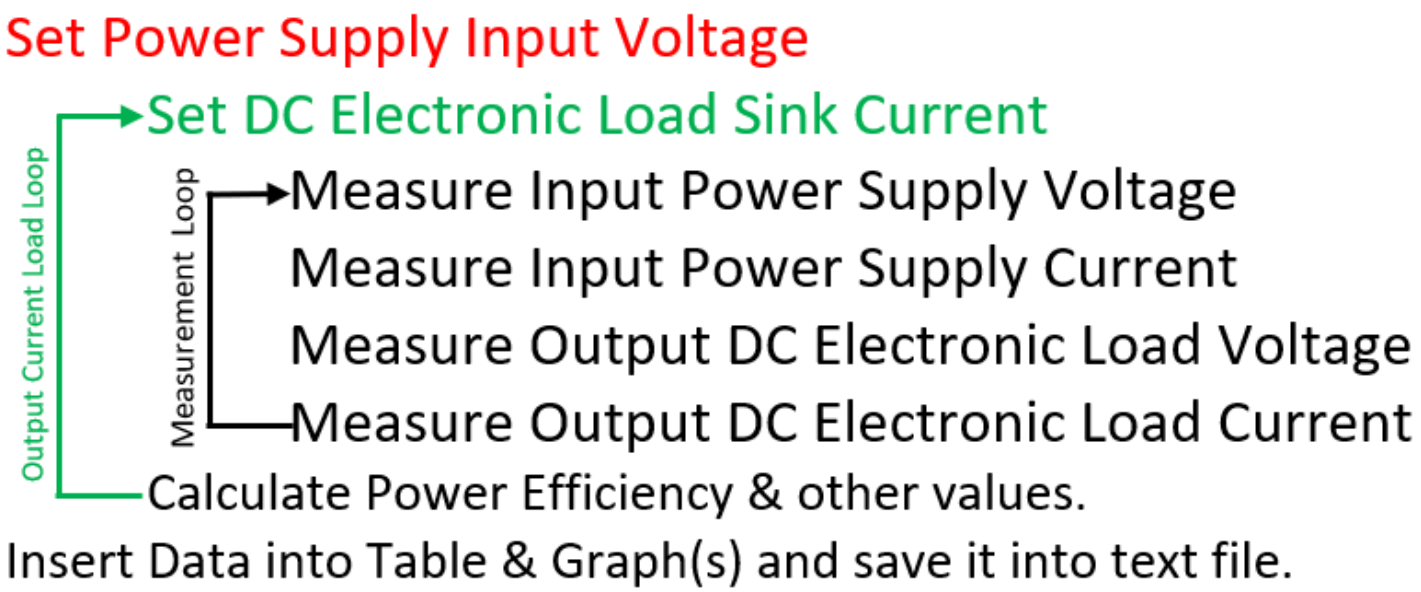


Figure 4: The Software loop for calculating power efficiency (%) for single input voltage and multiple output current load values. This loop is enabled by checking the single input (no sweep) check box in the test start box.

Main Software Window

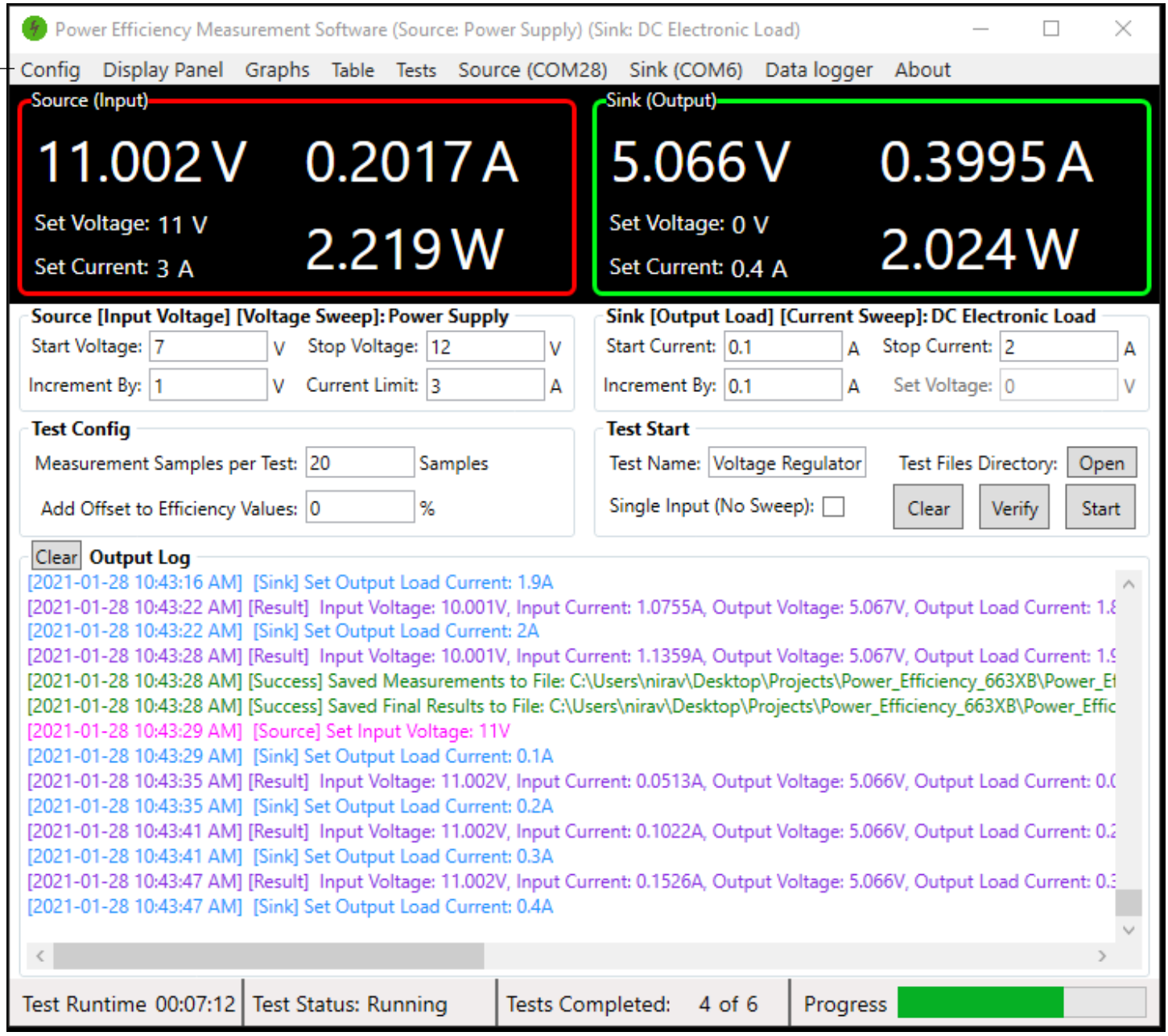


Figure 5: The main software window while tests are being completed. It is recommended to not interact with any software windows like graph windows as doing to may slow the testing down as the UI thread has a higher priority that the test loop function.

Click the config menu and then click connect to open the COM select window.

COM Select Window

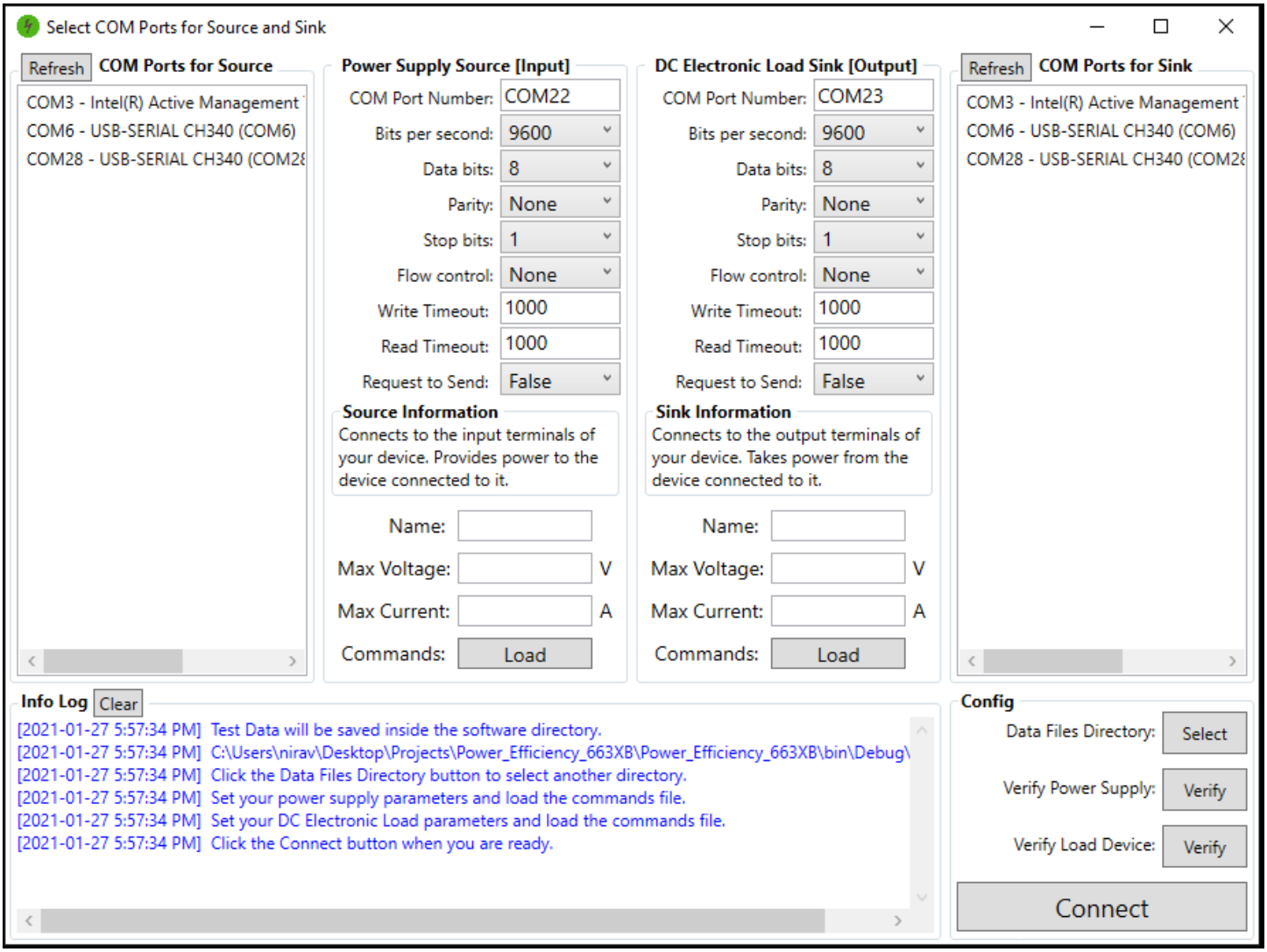


Figure 6: The most important window, the software will not function without properly configuring your power supply and dc electronic COM connections.

How to connect your Power Supply to the software

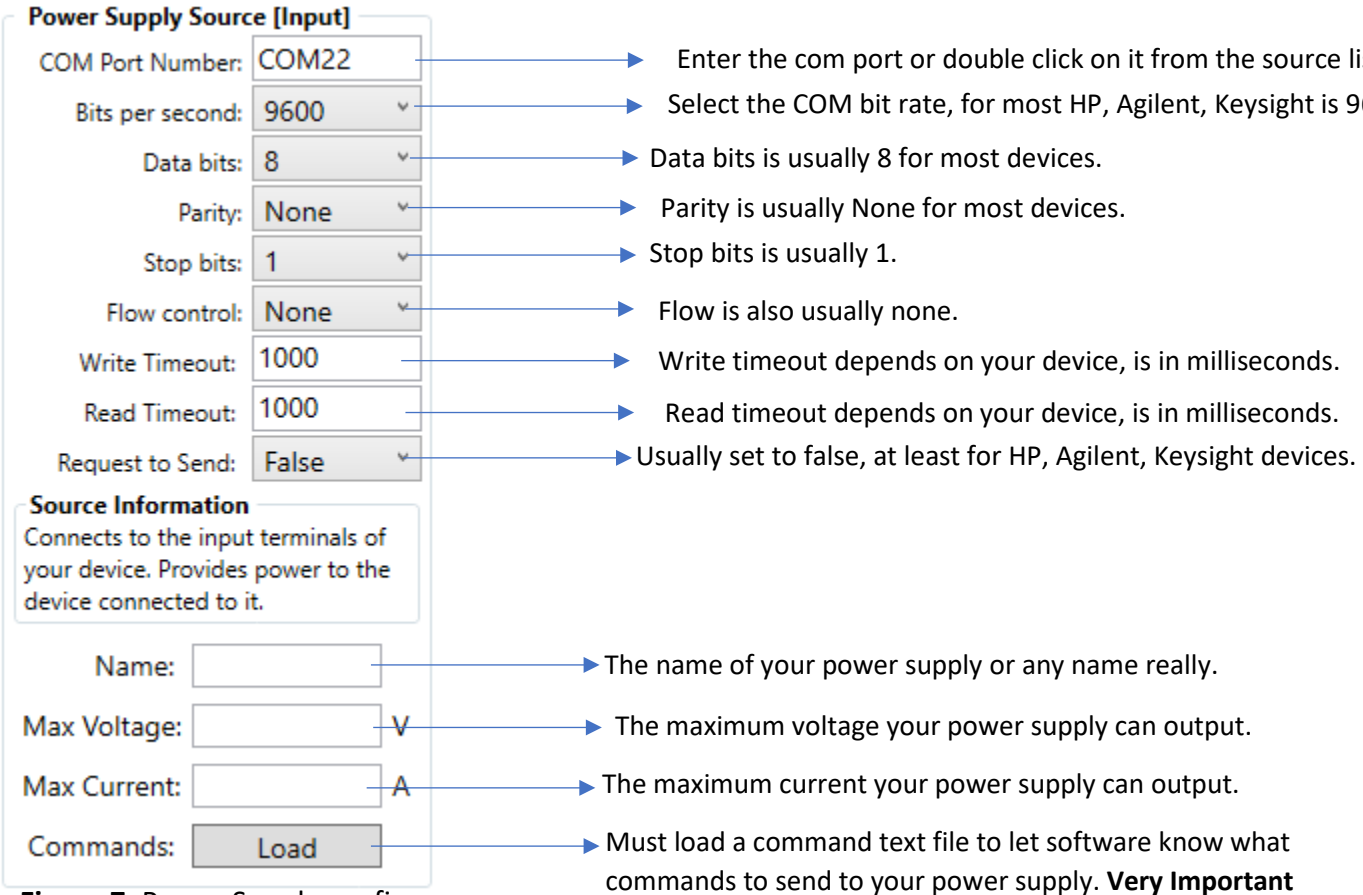


Figure 7: Power Supply config box.

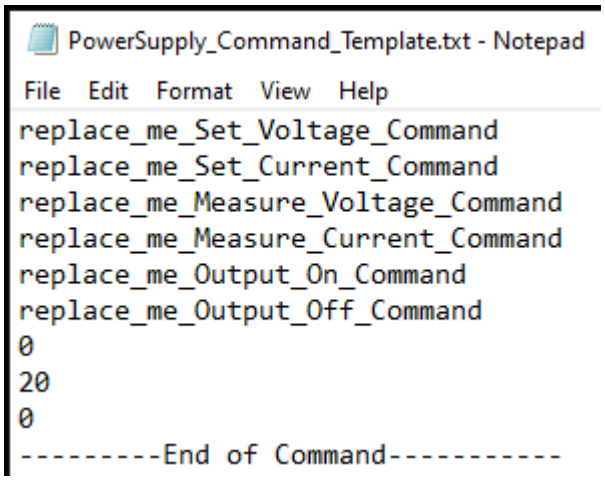


Figure 8: This power supply command template text file can be found inside the software's directory, located inside the Command files folder.

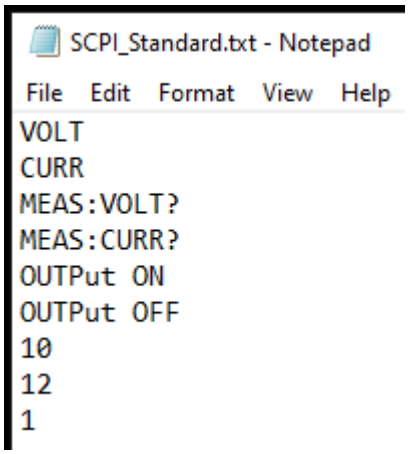


Figure 9: This is what a proper command file should look like.

How to connect DC Electronic Load to the software

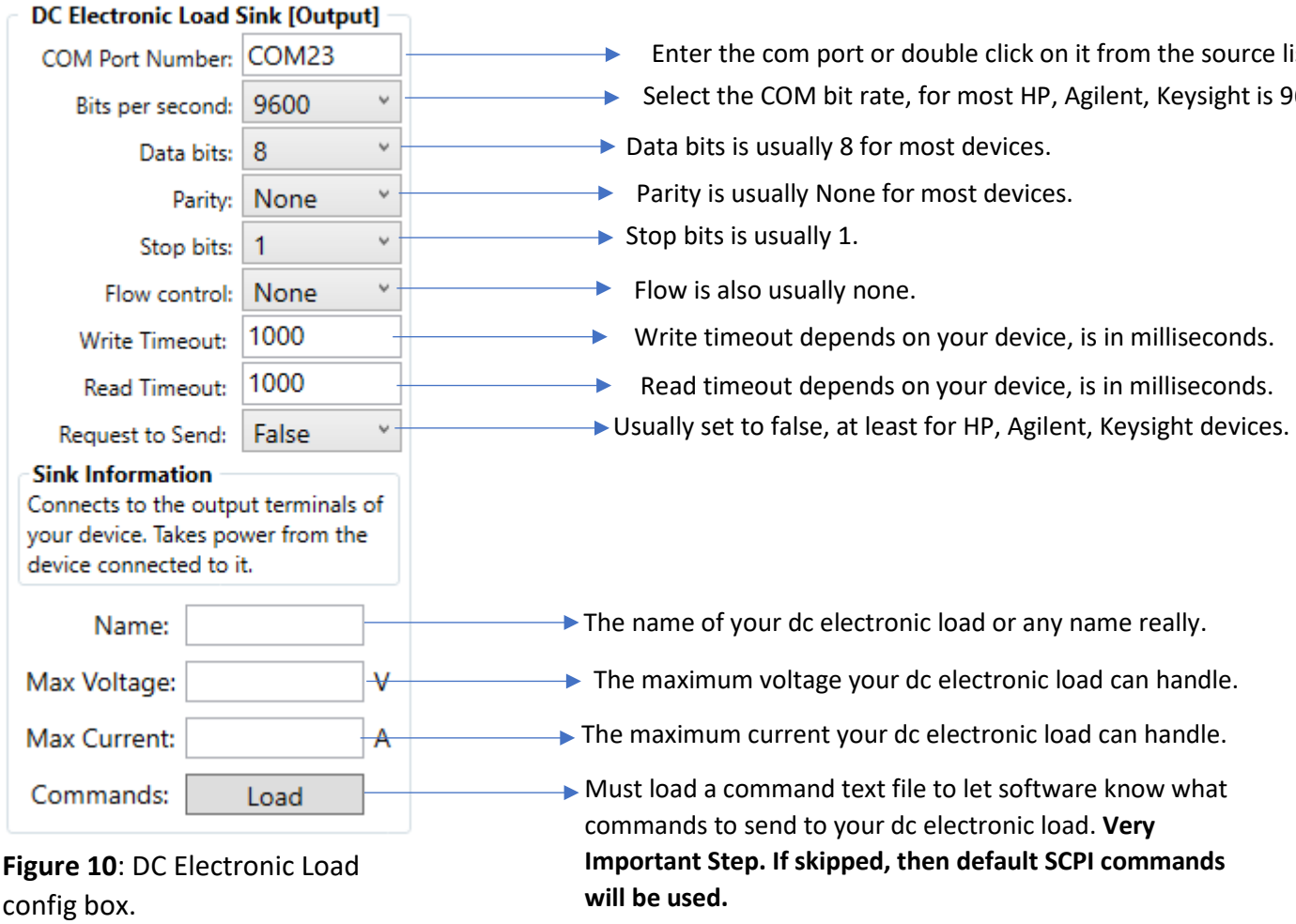


Figure 10: DC Electronic Load config box.

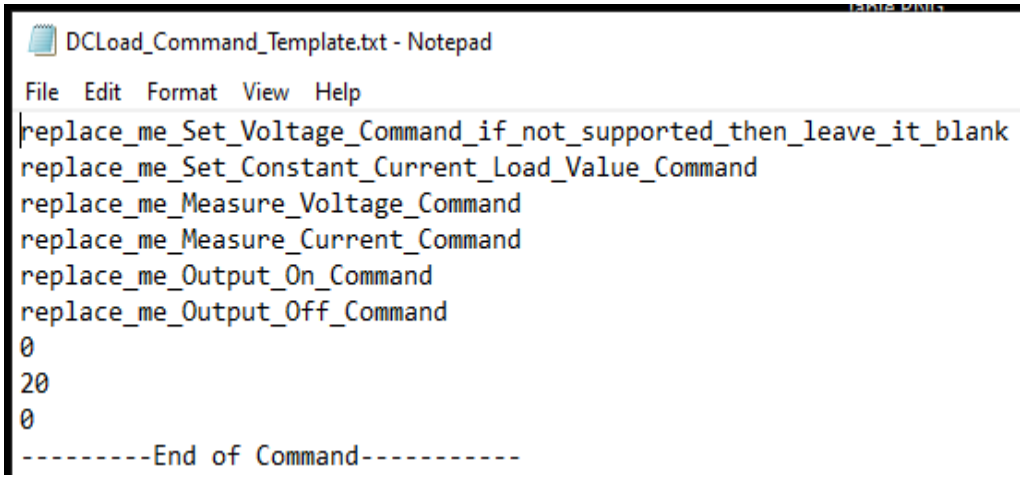
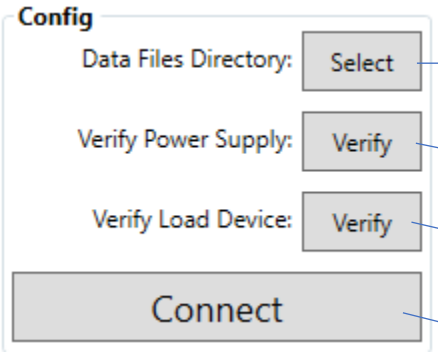


Figure 11: This dc electronic load command template text file can be found inside the software's directory, located inside the Command files folder.

Config Box, Ready to Connect



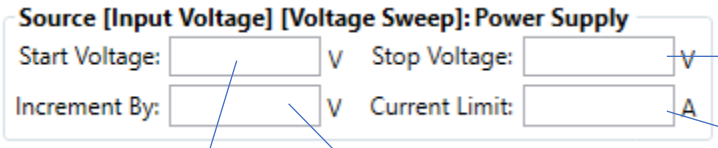
By default, all data will be saved inside the software directory, but you can change that by clicking here.

Verify your power supply config parameters by clicking here.

Verify your dc electronic load config parameters by clicking here.

Once you are ready, click connect. You will not be able to return to this COM window. You will have to exit the software and open it again to access it. Choose your setting carefully.

Input and Output Parameters Explained

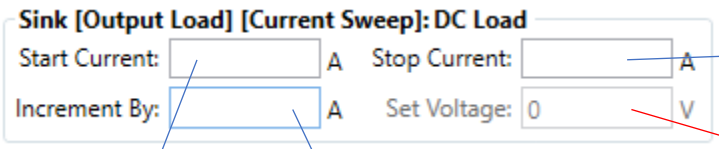


The final input voltage you want your circuit to be tested for. The software may not reach this value depending on increment value.

Your power supply must operate in constant voltage mode (CV), set the current limit so that you power supply stays in CV mode.

The value the software will sweep input voltage values from start to finish. Larger number means less tests.

The initial input voltage you want your circuit to be tested for.

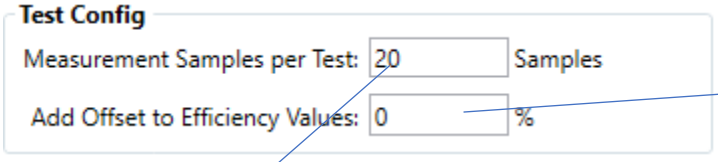


The final output load current value you want your circuit to be tested for. The software may not reach this value depending on increment value.

Should not be used, useful for 2/4 quadrant power supplies. Not so much for dc electronic loads. Disabled by default.

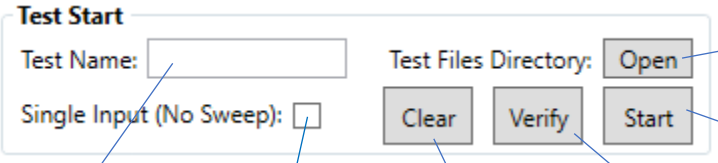
The value the software will sweep output load current values from start to finish. Larger number means less tests.

The initial output load current value you want your circuit to be tested for.



Adds an offset value to final efficiency result, not very helpful.

Measurement Samples per current load value. 1 measurement sample = 4 measurements.



Opens data folder, where your data is.

Starts the testing procedure.

Verifies your Source and Sink parameters. Safety Checks.

Name your test or not.

Check this box to test circuit for only 1 input voltage.

Clears input text fields.

How to Access Graphs and Table (must be opened before test start)

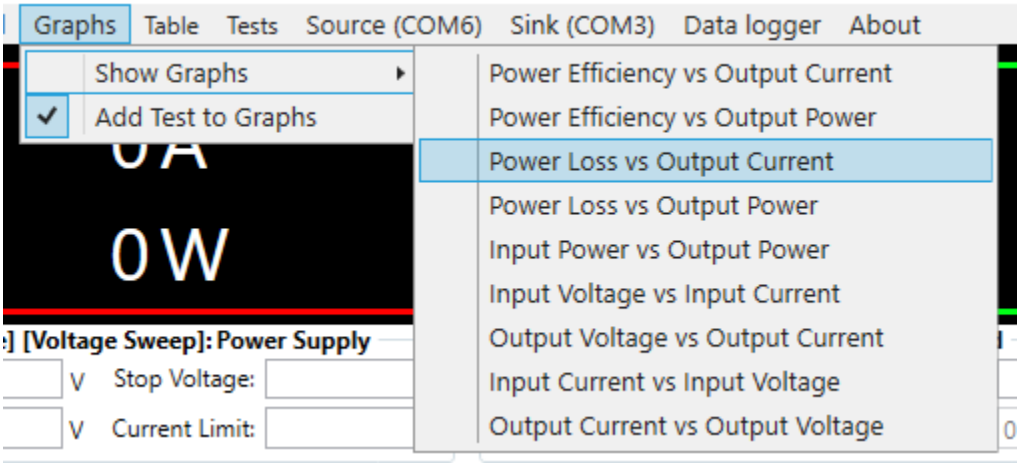


Figure 12: You may open any graph window you like or just open all of them. The more graphs you open the more CPU processing power will be used. The RAM usage will also increase.

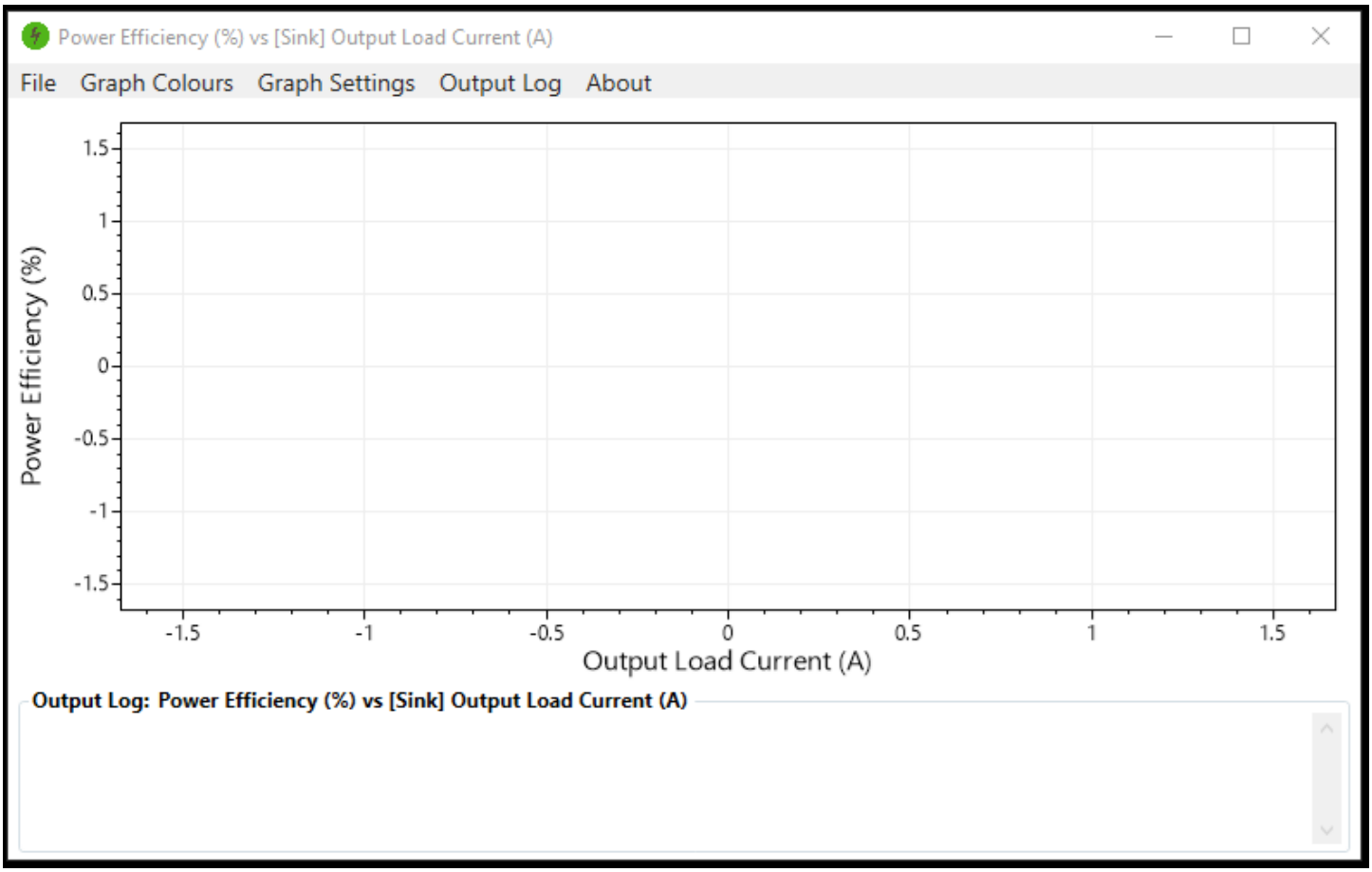


Figure 13: Graphs must be opened before you start the test.

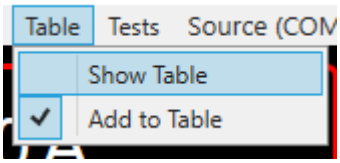


Figure 14: Click show table to open the table, must be opened before starting the tests.

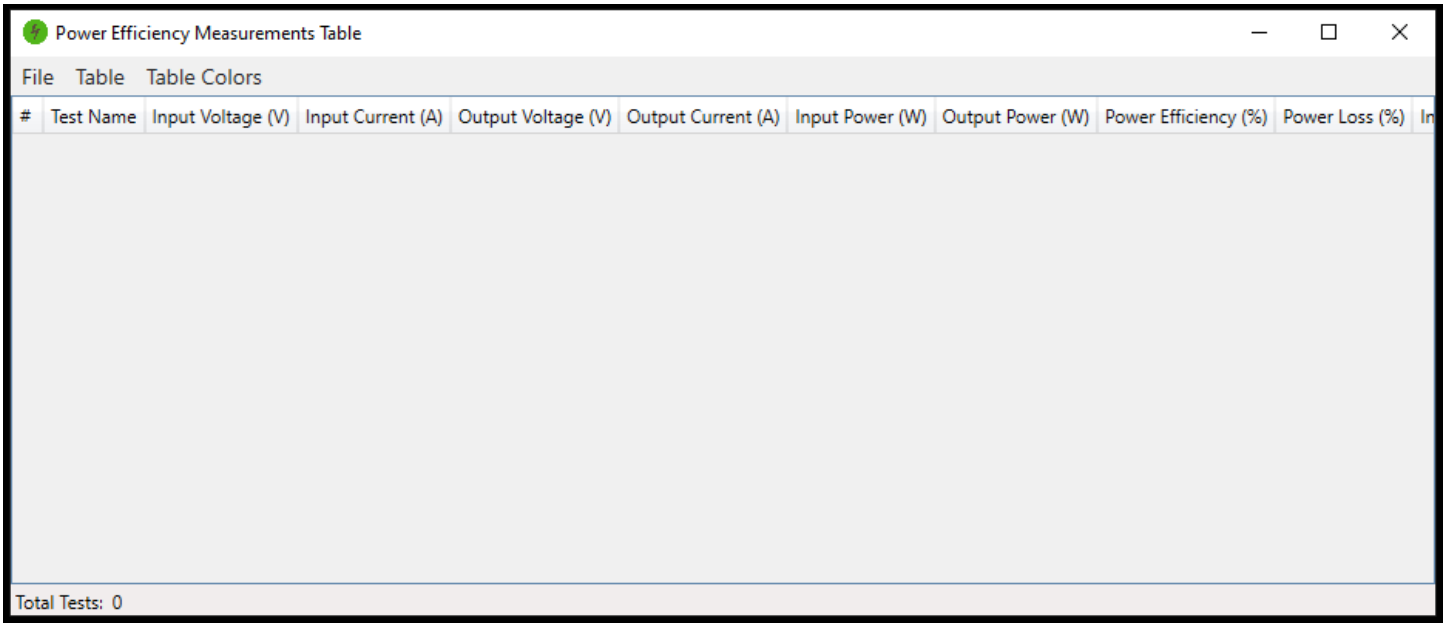


Figure 15: Data will automatically be added to the table as tests are completed.

Send Serial Commands

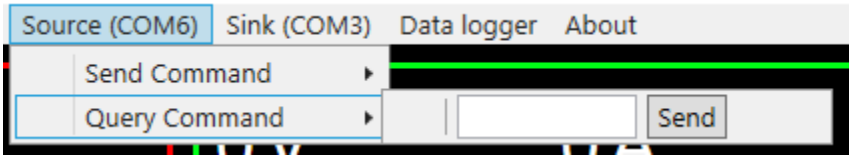


Figure 16: For some instruments you may have to send additional commands before starting the tests.

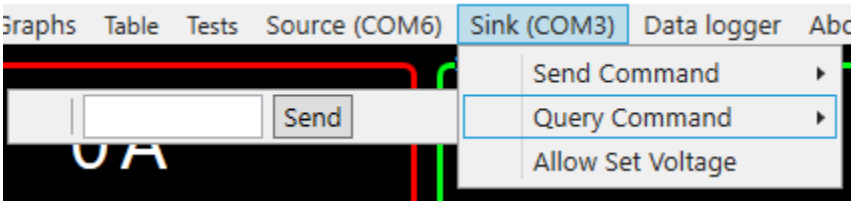


Figure 17: Do not enable set voltage for Sink.