

Increase the measurement speed with NOVA

Case study: how to increase the measurement speed by optimizing the USB communication with the Autolab?

One of the FAQ from NOVA users is:

A FRA measurement over several frequency decades can take several minutes. Is it possible to speed up the measurement?

USB 1.1 vs USB 2.0

Although the Autolab uses a USB 1.1 controller to time the measurements, it is possible to accelerate data transfer in between the Autolab and the host computer. This can be achieved by connecting the Autolab to a USB 2.0 powered hub rather than to the computer directly.

This hub can then be connected to a USB 2.0 port on the host computer. This setup will force Windows to assign control of the Autolab PGSTAT to the *Enhanced USB* controller rather than the *Universal USB* controller. This can dramatically increase the communication speed between the Autolab and the host computer.

No software upgrade is required for this connection setup. Any powered USB 2.0 hub will do.

Benefits

Using the setup described in this technical note increases the communication speed between the Autolab and the host computer. This means that the following processes will become significantly faster:

- Uploading the Autolab interface
- Data transfer from the Autolab to the host computer
- Data transfer from the host computer to the Autolab
- Uploading of NOVA procedure to the Autolab after validation
- Real time display of data points in the measurement view

The increase in transfer rate between the Autolab and the computer also means that procedures involving a lot of data transfer (like FRA measurement, or measurements with a repeat loop) will become faster.

For illustration purposes, a FRA frequency scan in potentiostatic mode, from 10 kHz to 0.1 Hz, 10 mV amplitude (rms), 50 frequencies with logarithmic distribution would take about 9 minutes to complete under normal circumstances and would take about 4 and ½ minutes with the USB 2.0 control setup.

Benchmark comparison

To illustrate the increase in measurement speed a total of three procedures were used as benchmarks. The procedures are tested on the Autolab dummy cell, using both communication protocols.

Cyclic voltammetry potentiostatic

The Autolab cyclic voltammetry potentiostatic was used as provided on dummy cell (c). Figure 1 shows the recorded data points plotted versus time. The time corresponds to the absolute time since the beginning of the experiment and it includes the preconditioning time (5 seconds in the procedure) and the time required to upload the procedure to the Autolab after validation. Using the normal USB control (USB 1.1), the time coordinate of the first data point is 7.7 seconds. Using the USB control described in this technical note, the first data point is recorded after 5.7 seconds, resulting in a net gain of 2 seconds.

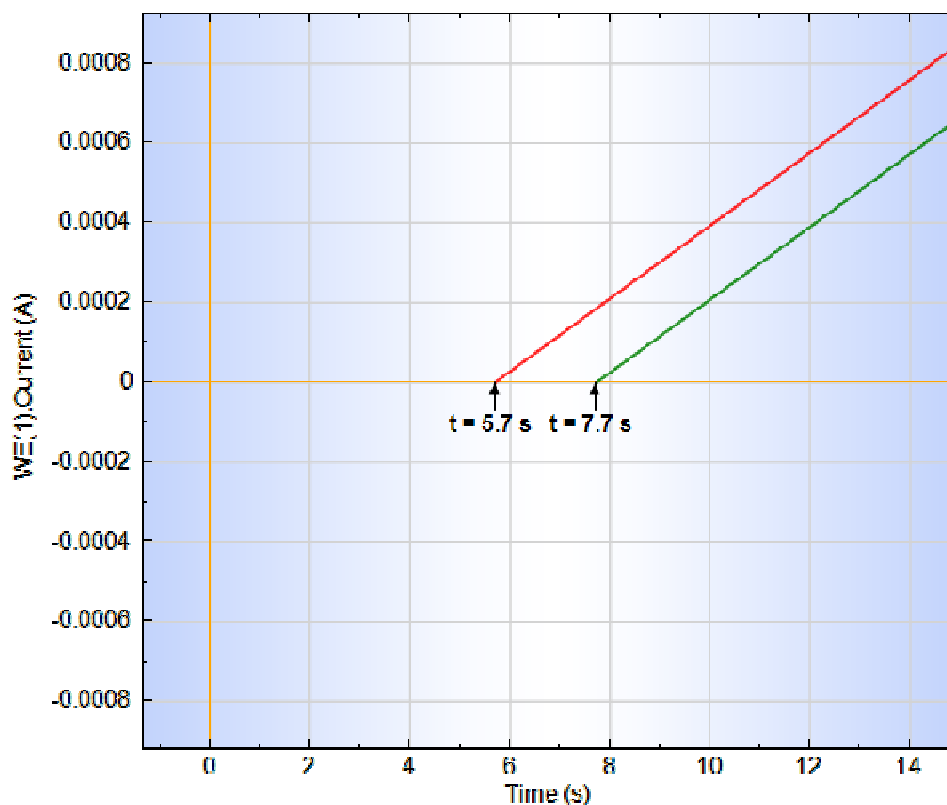


Figure 1 – The data points recorded with the Cyclic voltammetry potentiostatic procedure (red curve – USB 2.0 control, green curve – USB 1.1 control)

Chrono charge/discharge

The Autolab chrono charge discharge procedure was used as provided on dummy cell (a). Figure 2 shows the recorded data points obtained using the normal Autolab connection (USB 1.1), plotted versus time. The time corresponds to the absolute time since the beginning of the experiment and it includes the preconditioning time (10 seconds in the procedure) and the time required to upload the procedure to the Autolab after validation. Additional delays are introduced by the repeat loop. The total duration of the experiment is 92.3 seconds.

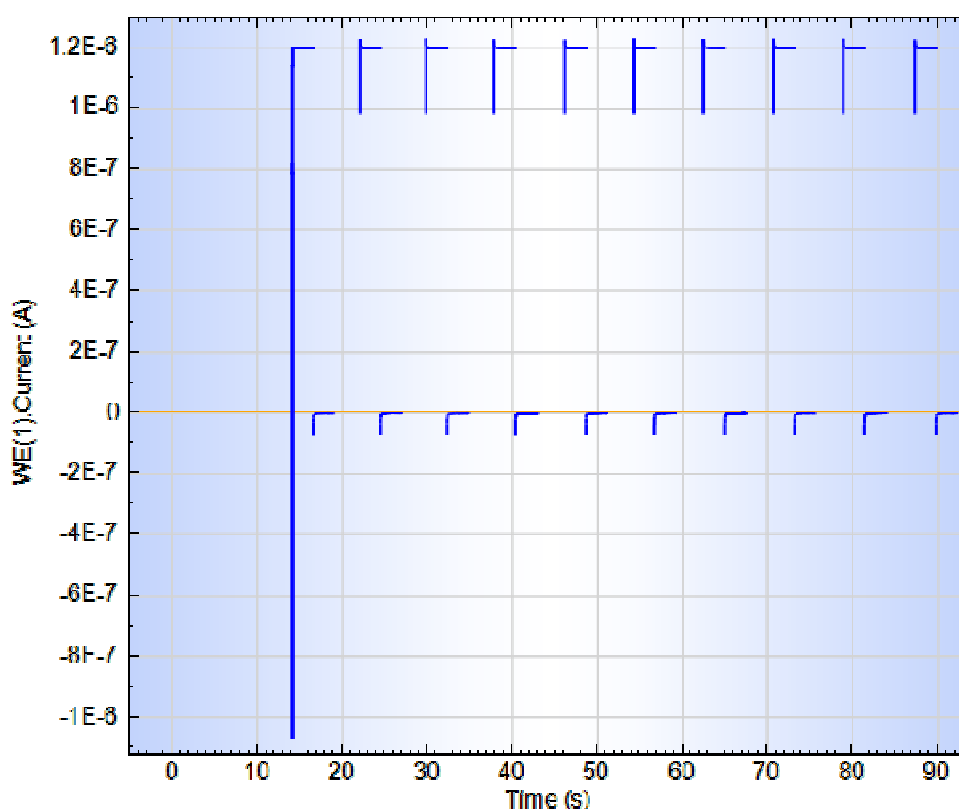


Figure 2 – The data points recorded with the chrono charge discharge procedure, using the USB 1.1 control

Figure 3 shows the recorded data points obtained using the improved Autolab connection described in this technical note (USB 2.0), plotted versus time. The time corresponds to the absolute time since the beginning of the experiment and it includes the preconditioning time (10 seconds in the procedure) and the time required to upload the procedure to the Autolab after validation. Additional delays are introduced by the repeat loop. In this case, the total duration of the experiment is 72.3 seconds, resulting in a net gain of 20 seconds.

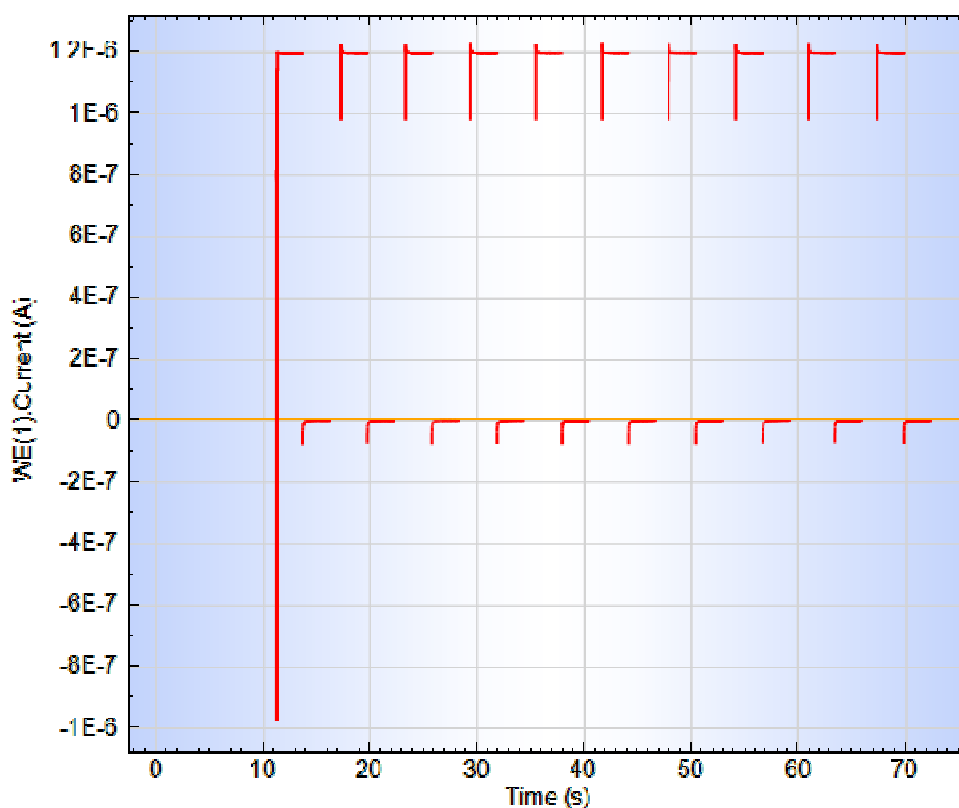


Figure 3 - The data points recorded with the chrono charge discharge procedure, using the USB 2.0 control

Closer inspection of the data points reveals that the time delay introduced by the repeat loop is drastically reduced with the USB 2.0 communication protocol (see Figure 4). When the normal communication protocol is used, the time delay introduced by the repeat loop is roughly 3 seconds (22 s – 19 s). When the USB 2.0 communication protocol is used instead, the overhead time introduced by the repeat loop is reduced to ca. 1 second, resulting in a net gain of 2 seconds for each repetition¹.

¹ The count is therefore: 9 repeat loops, 2 second gain plus 2 seconds gained during the procedure upload = 20 seconds.

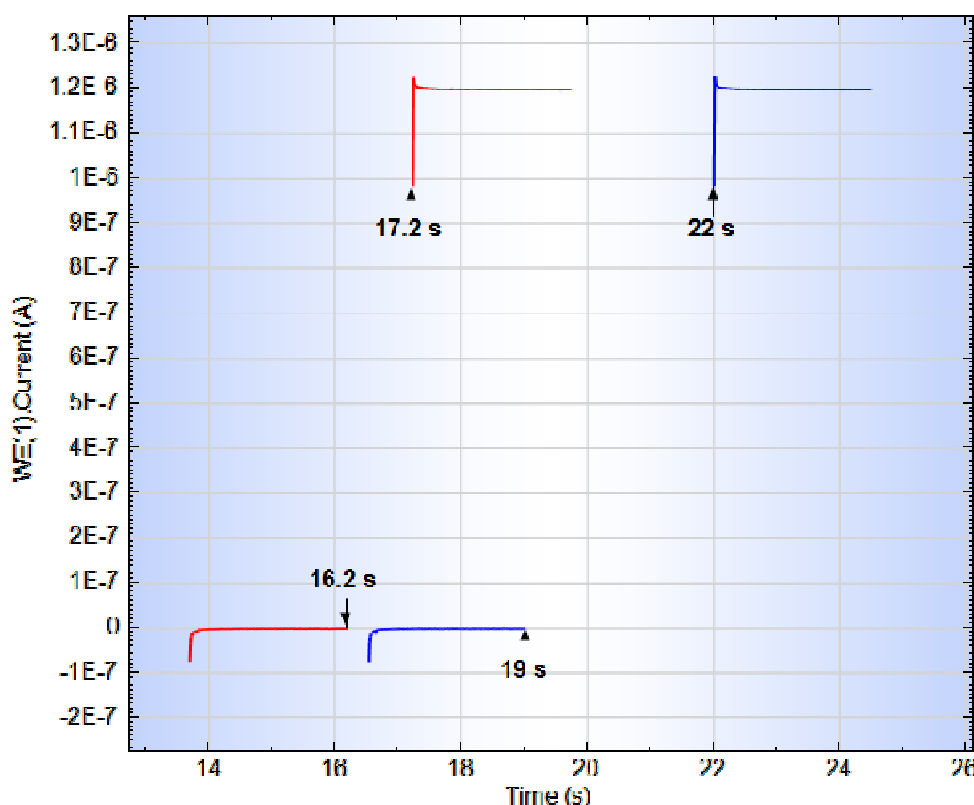


Figure 4 – Time delay introduced by the repeat loop shown in detail for the first repetition (red curves – USB 2.0 control, blue curves – USB 1.1 control)

FRA impedance potentiostatic

The estimated time required to complete this measurement on dummy cell (c) is about 9 minutes. In practical measurement, using the USB 1.1 communication protocol, the total measurement time was slightly higher, around 10 minutes. This difference stems from the measurement repetitions introduced by gain or current range switches.

Repeating the same measurement using the USB 2.0 communication protocol reduced the duration of the frequency scan to less than 5 minutes.

Conclusion

These tests have clearly shown the benefit of using an additional USB 2.0 powered hub between the Autolab and the host computer. The communication speed is increased which in turn results in faster measurements. This can be quite useful, especially during time-critical experiments.