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**EMF 2 and EMF 6 Precision Electrochemistry Interface
with Graphics Software for Win 98/NT/ME/2K/XP/Vista/Win7/Win8/Win10**

Table of Contents

1 Getting Started	<u>2</u>
2 Hardware Installation	
A. Power and USB Connections	<u>2</u>
B. Driver for Win XP (32-bit)	<u>3</u>
C. Driver for 64-bit XP/Win7/Win8/Win10	<u>9</u>
3 Software Installation	<u>10</u>
4 Operation	
A. Location of controls	<u>16</u>
B. Text Screen	<u>18</u>
C. Basic Operation	<u>19</u>
D. Scan Setup	<u>19</u>
E. Offsets	<u>22</u>
F. Data Files	<u>22</u>
5 Troubleshooting	<u>24</u>
6 EMF6 Block Diagram	<u>26</u>
7 EMF2 Block Diagram	<u>27</u>

1 Getting Started

Minimum Hardware Requirements

486 PC or better, with at least 32 MB RAM.
one free USB port
internet connection, for installation only
Windows XP or newer

Note: The hardware and software will run under Windows 98/ME/Win2000. Contact the factory for installation details. Operation is the same.

Before you begin

You need either an EMF 2 or an EMF 6 with the wall-mount power supply and a USB cable. *For a 32-bit operating system, do not plug in the USB cable until instructed to do so.*

The EMF 2 and EMF 6 connect via USB. Drivers are required in order to communicate with the hardware. The driver for 64-bit Windows is signed, and will install automatically. For 32-bit Windows, the driver installation instructions follow in the next section.

In all cases, you will need to download and install the free application software.

2 Hardware Installation

A. Power and USB Connections

The EMF 2 and EMF 6 are supplied with a wall-mount power supply. If it is of the interchangeable plug variety, first, install the appropriate plug. Be certain it snaps all the way into place, or a shock hazard could result.

Plug in the power supply at both ends. These instruments are very low power devices, so no power switch is necessary. For lowest power consumption when not in use, use a switched power outlet.

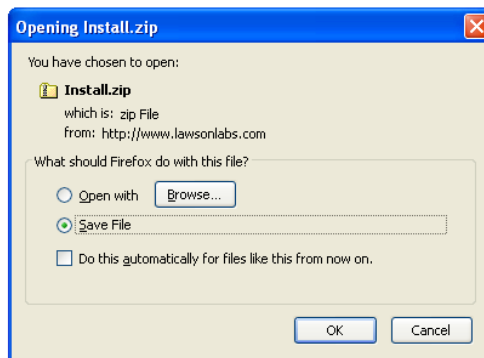
The USB cable plugs into both the EMF 2 or EMF 6 and your computer. Each physical USB connector is treated individually, so it is best to always use the same one. Multiple instruments can be installed on multiple USB ports, and they will remain independent.

For 64-bit Windows, skip to section **2 C**.

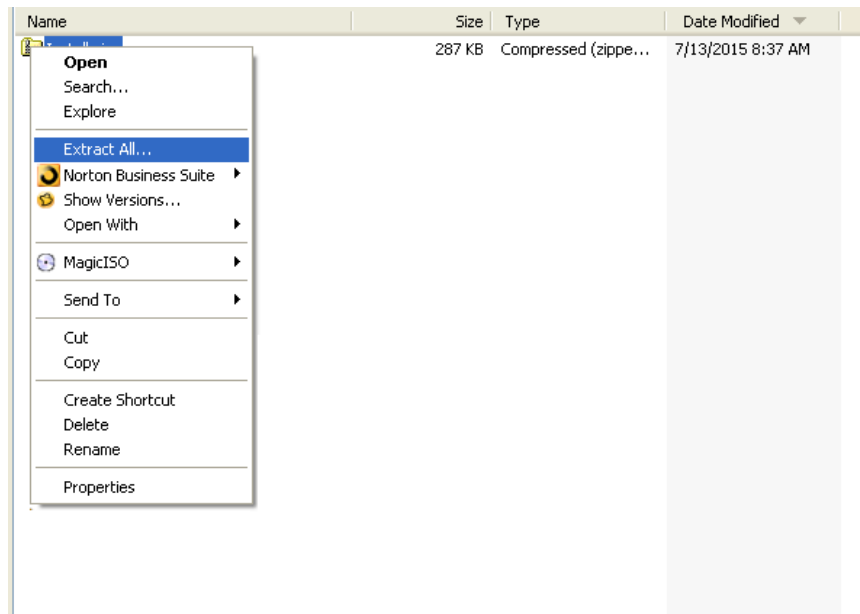
B. Driver for Win XP (32-bit)

Before you plug in the USB cable you must download the correct drivers for your hardware. Do not allow Windows to install the "default driver". The default driver will not function, and will take extra work to uninstall.

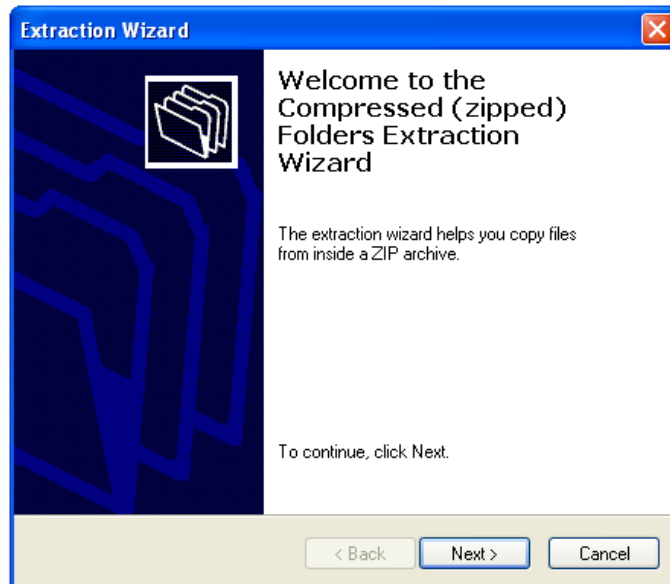
At www.lawsonlabs.com, navigate to the EMF 2 or EMF 6 page and select Software, then Drivers. Next, download the file called install.zip.



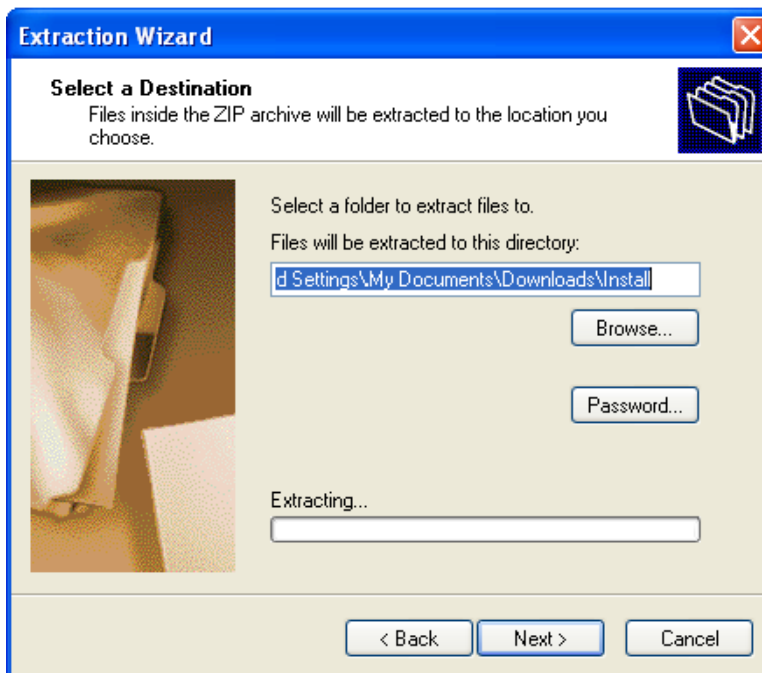
Locate install.zip where your browser places downloaded files. Right click on install.zip and chose "Extract All".



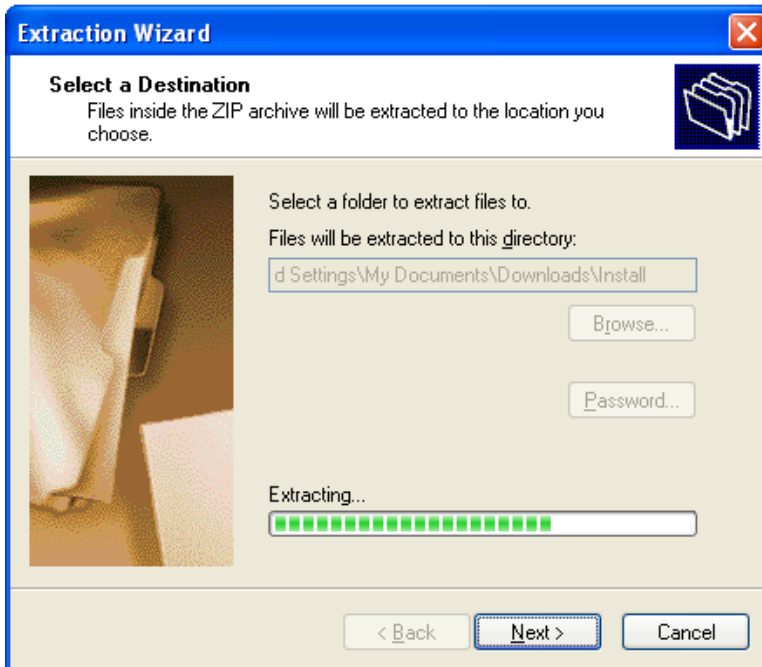
Click "Next"



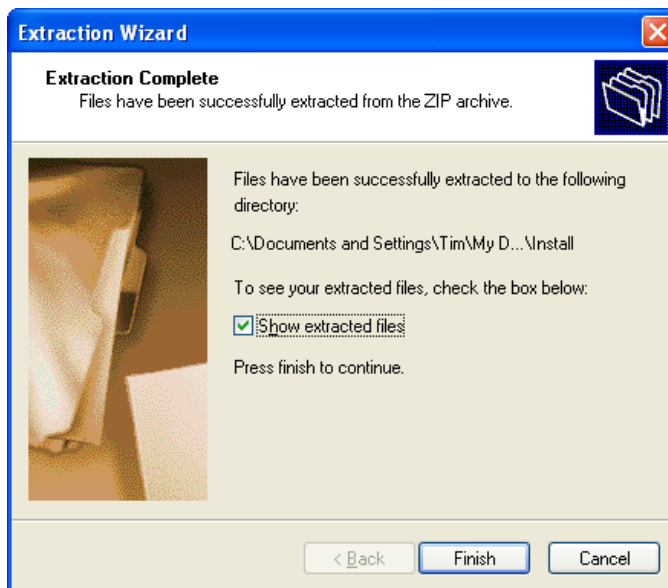
The default location for extracted files will be in a sub-folder called install. You can place your files wherever you chose. These files should only be needed once, so the default path is fine, as long as you note the exact path.



Click "Next"

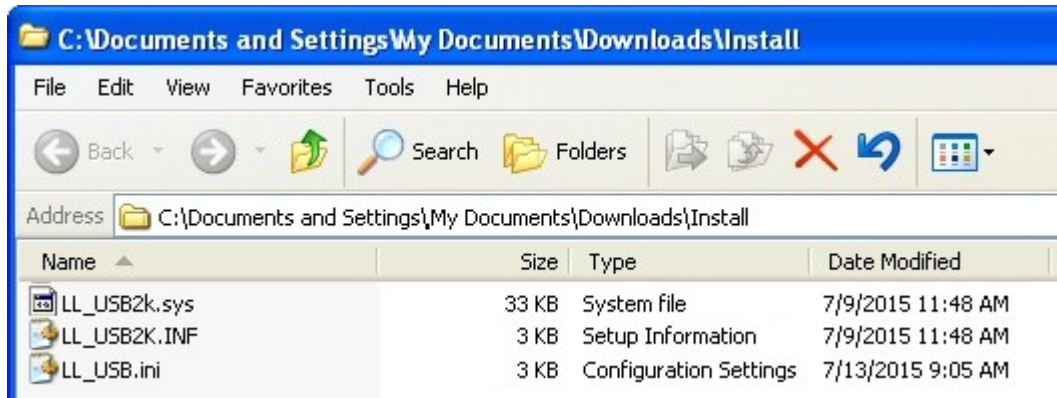


Select "show extracted files" option, if not already selected, then click "Finish"



A folder opens up showing the extracted files.

Remember the location of the extracted files – you will need to know the location in the next step of the installation.

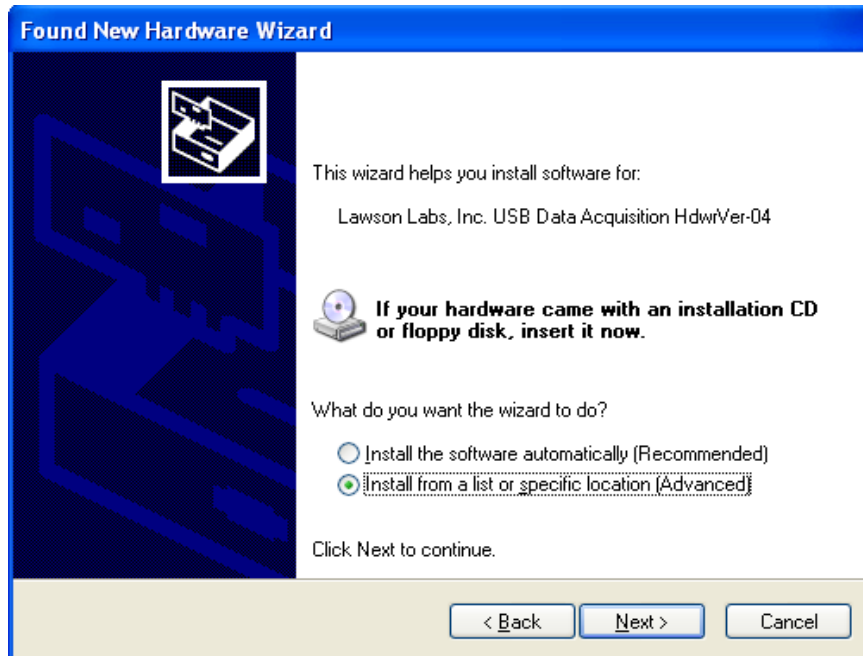


Connect the power supply to your EMF2 or EMF 6, and plug in the USB cable at both ends. The Windows installer will appear as shown below.

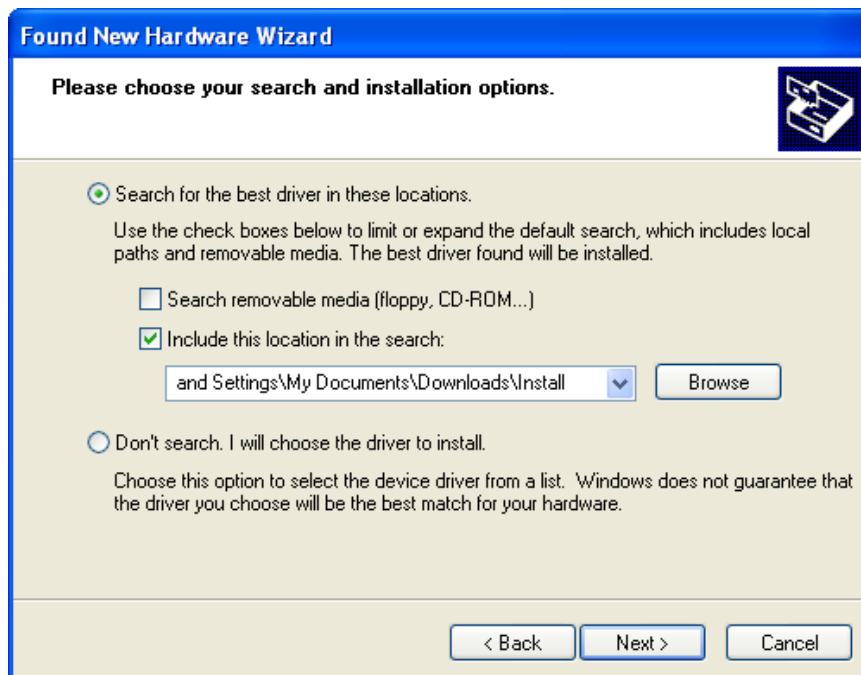
Select “No, not this time” for the Windows Update connection and click “Next”.



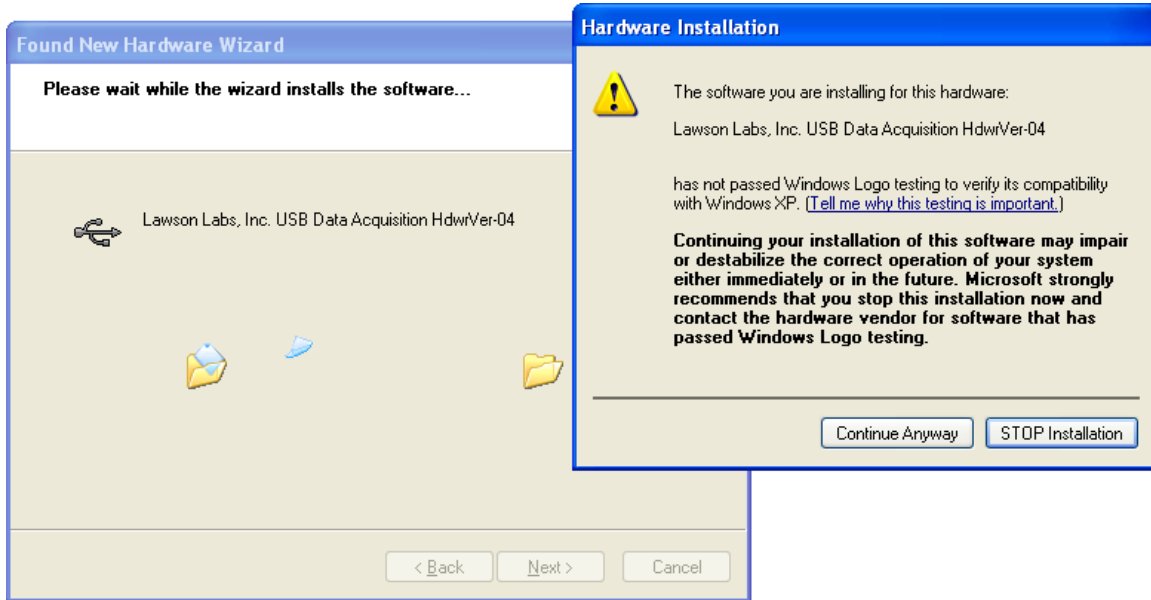
Select "Install from a list or a specific location" and click "Next".



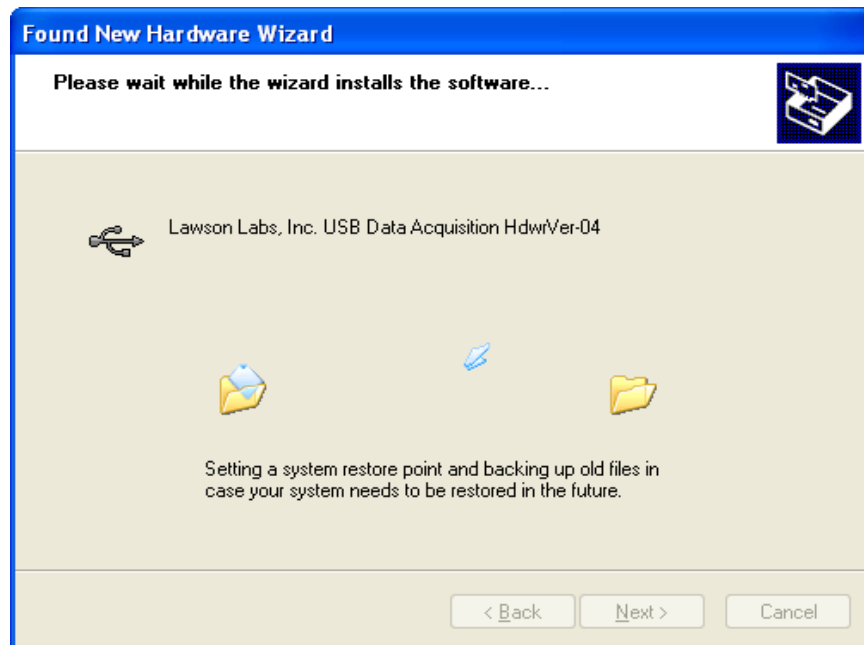
Use the "Browse" button to set the location to the "Install" folder where your extracted the files were placed, then click "Next".



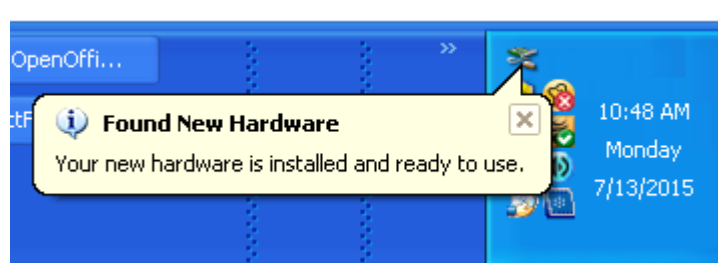
The 64-bit drivers are signed. The 32-bit drivers are not signed. There is no need for concern. Click “Continue Anyway”



Windows should then install the driver.



The taskbar will show a message indicating successful installation.



C. Driver for 64-bit Windows, including Win 7/8/10

Note: You need an internet connection for this step. If you do not have an internet connection on the target computer. Download the driver installation files from www.lawsonlabs.com on a connected computer, and follow the driver installation instructions there. A thumb drive is usually the easiest way to transport the files.

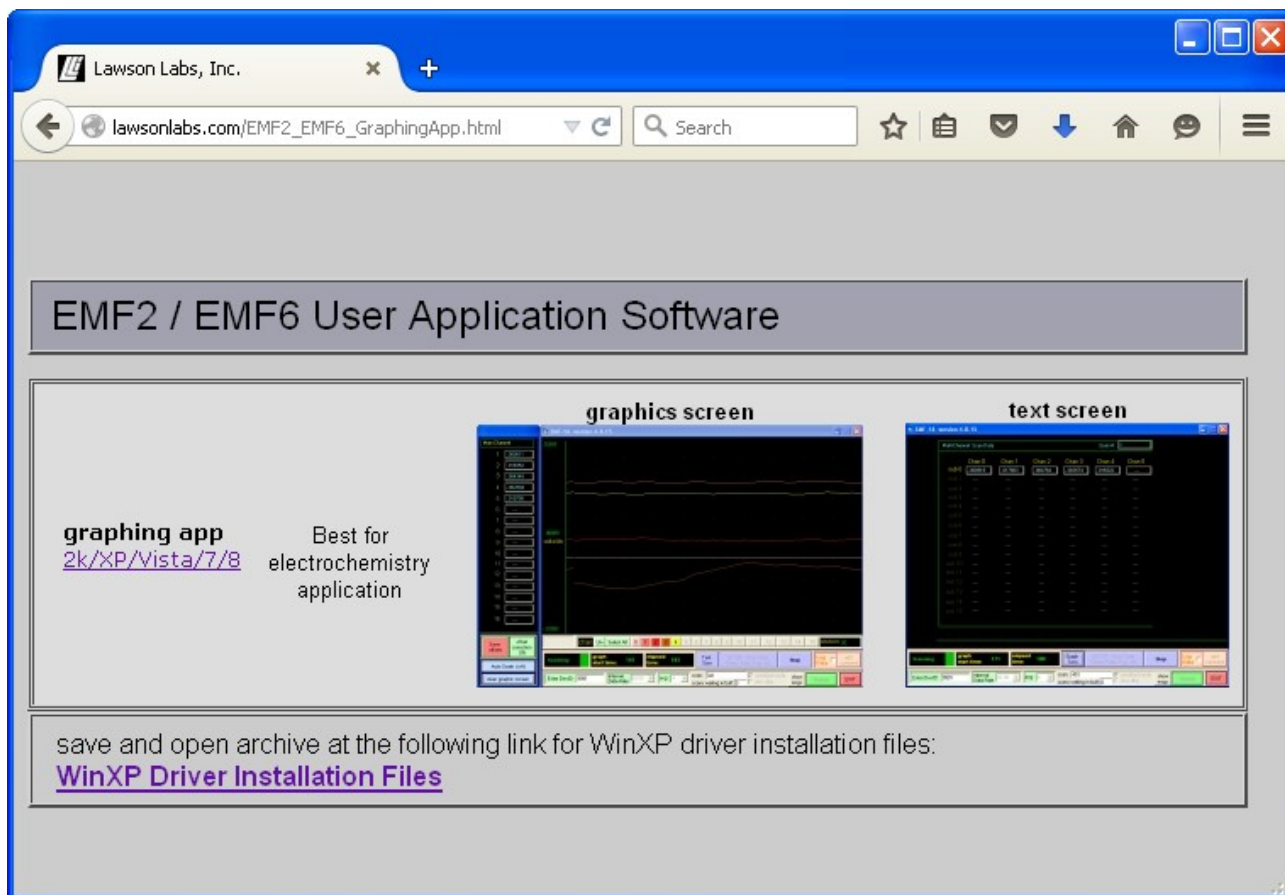
Connect the power supply to your EMF 2 or EMF 6 and plug in the USB cable at both ends.

The Windows installer should run automatically. You may or may not see a notice indicating your hardware is ready for use.

3 Software Installation

At www.lawsonlabs.com, navigate to the EMF 2 or EMF 6 page and select Software.

Click the "graphing app" link to download the archived files.

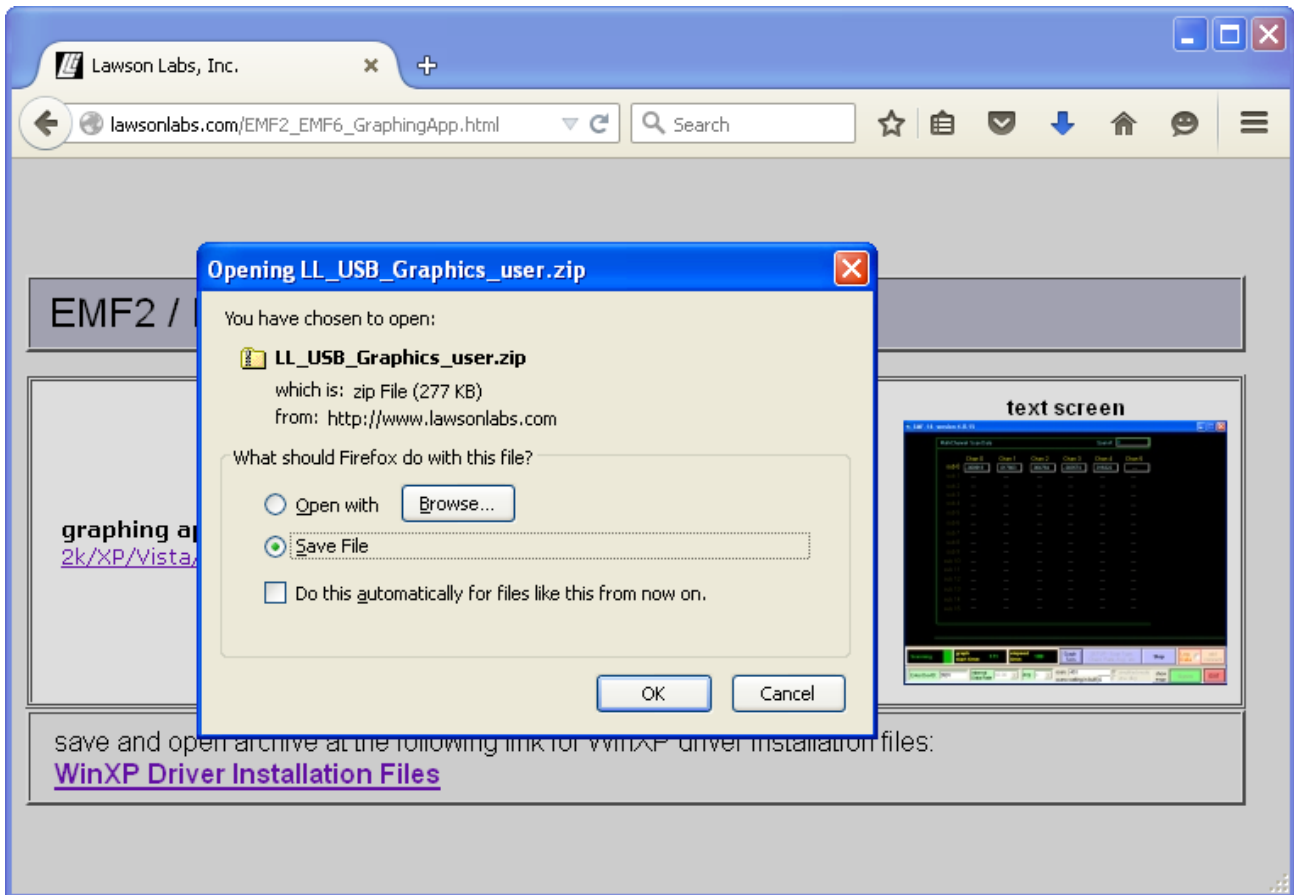


The screenshot shows a web browser window with the address bar displaying "lawsonlabs.com/EMF2_EMF6_GraphingApp.html". The page content includes a header "EMF2 / EMF6 User Application Software" and two main options:

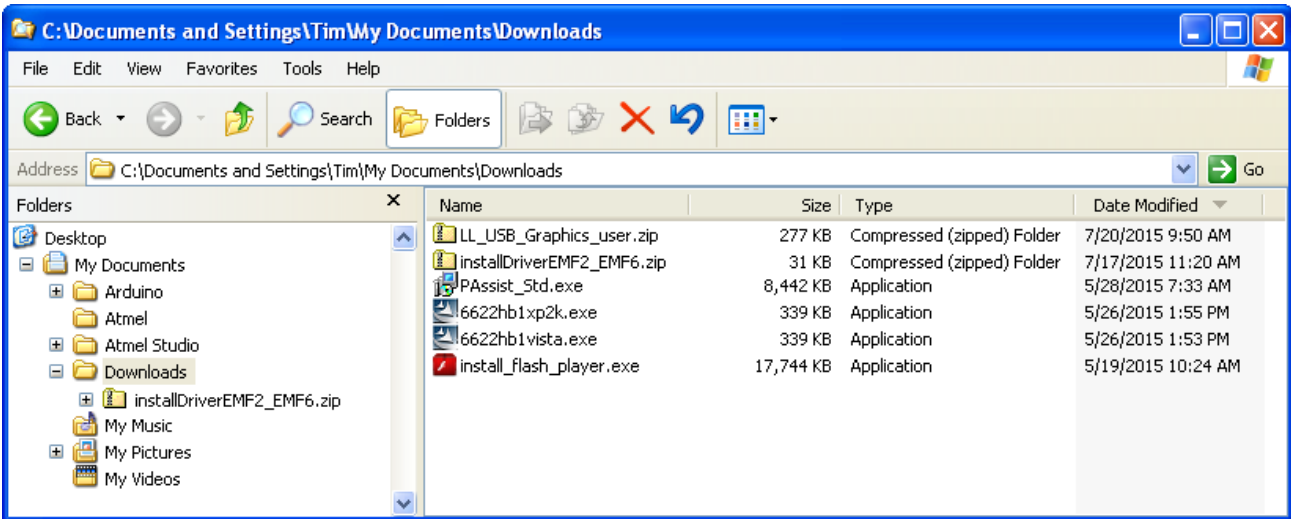
- graphing app**: [2k/XP/Vista/7/8](#) Best for electrochemistry application. This option is accompanied by a thumbnail image of a "graphics screen" showing a plot with multiple data series.
- text screen**: This option is accompanied by a thumbnail image of a "text screen" displaying a data table.

Below these options, a text box states: "save and open archive at the following link for WinXP driver installation files: [WinXP Driver Installation Files](#)".

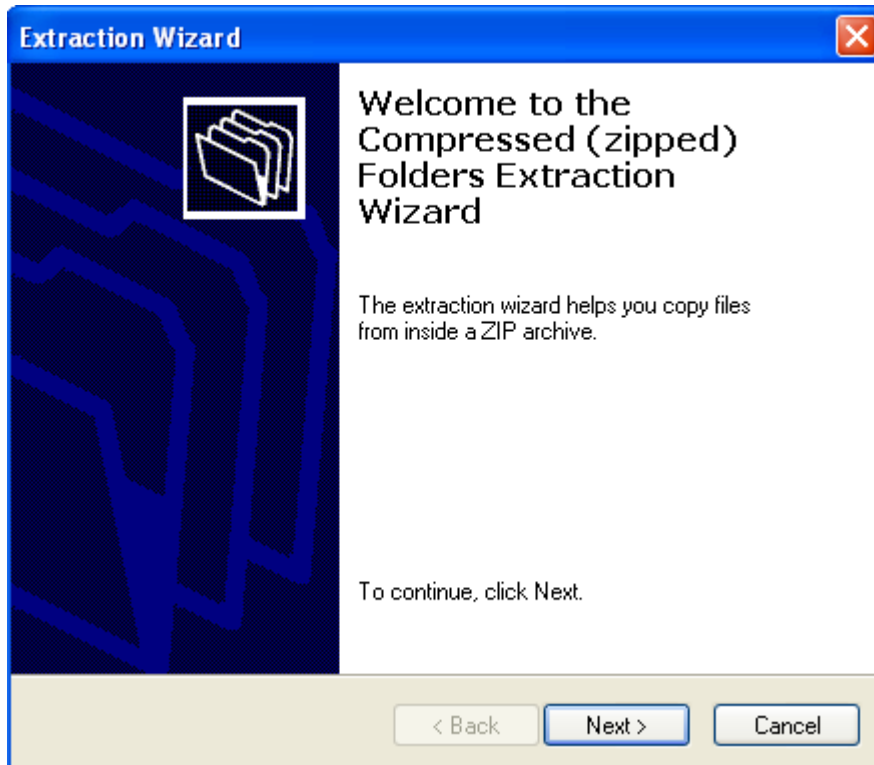
Save the LL_USB_Graphics_user.zip file.



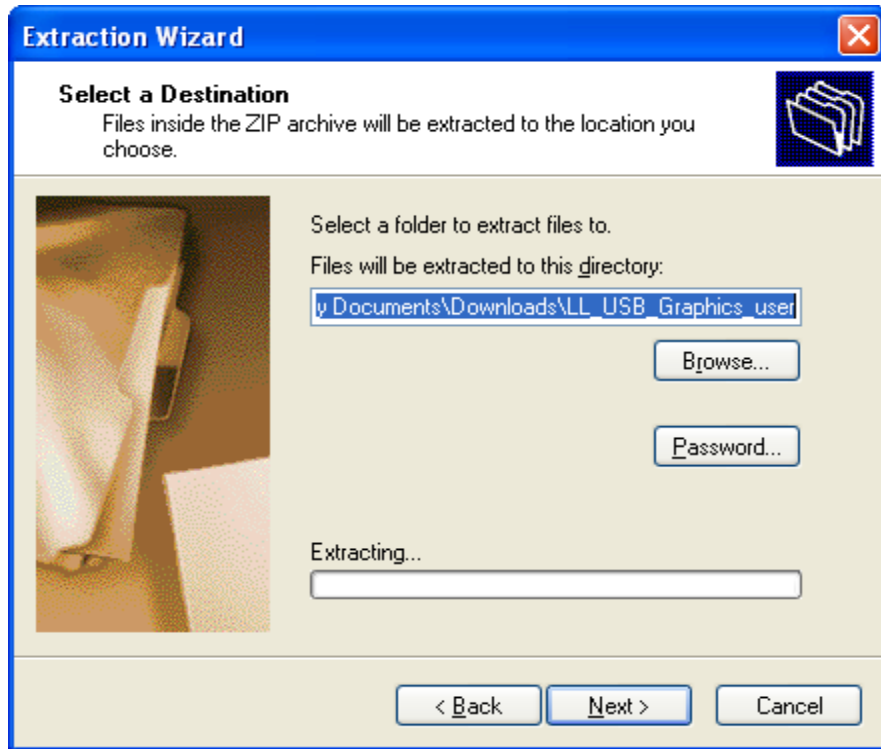
Locate " LL_USB_Graphics_user.zip" where your browser places downloaded files.



Right click on the zip file and chose "Extract All".

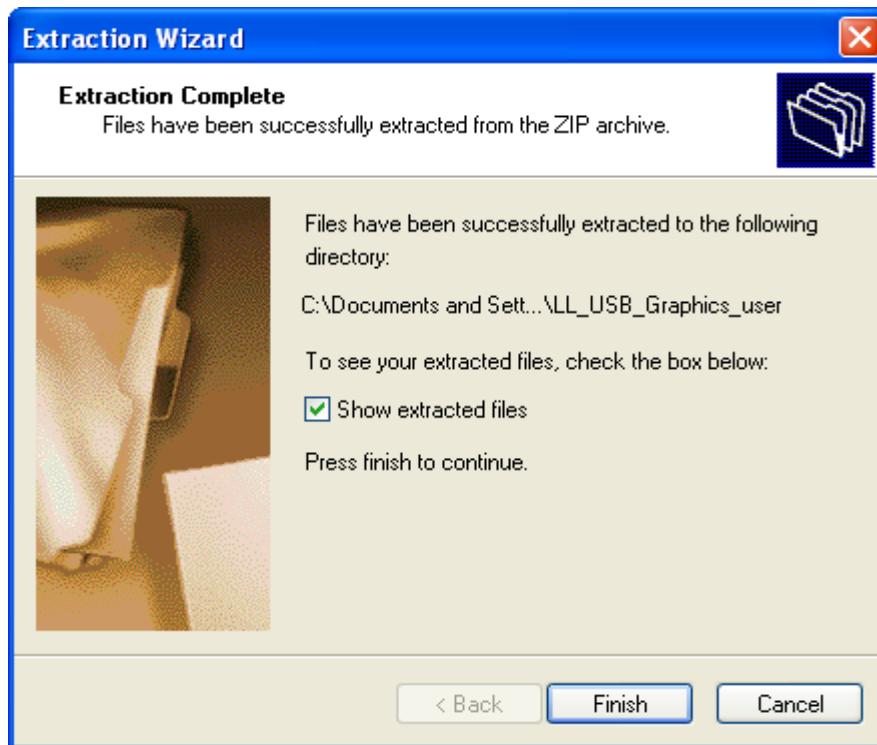


The default location for extracted files will be in a sub-folder called "LL_USB_Graphics_user". You probably would prefer another name and location.

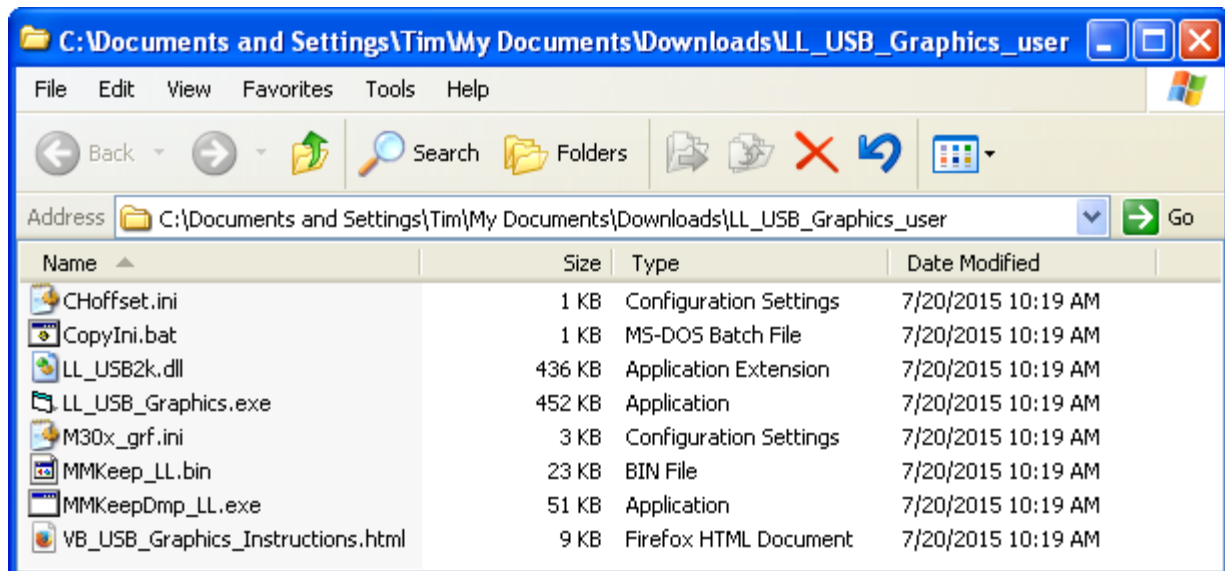


Click the Browse button to navigate to the desired location. You can create a new folder first, if desired, or you can copy the extracted files to the desired final location afterwards.

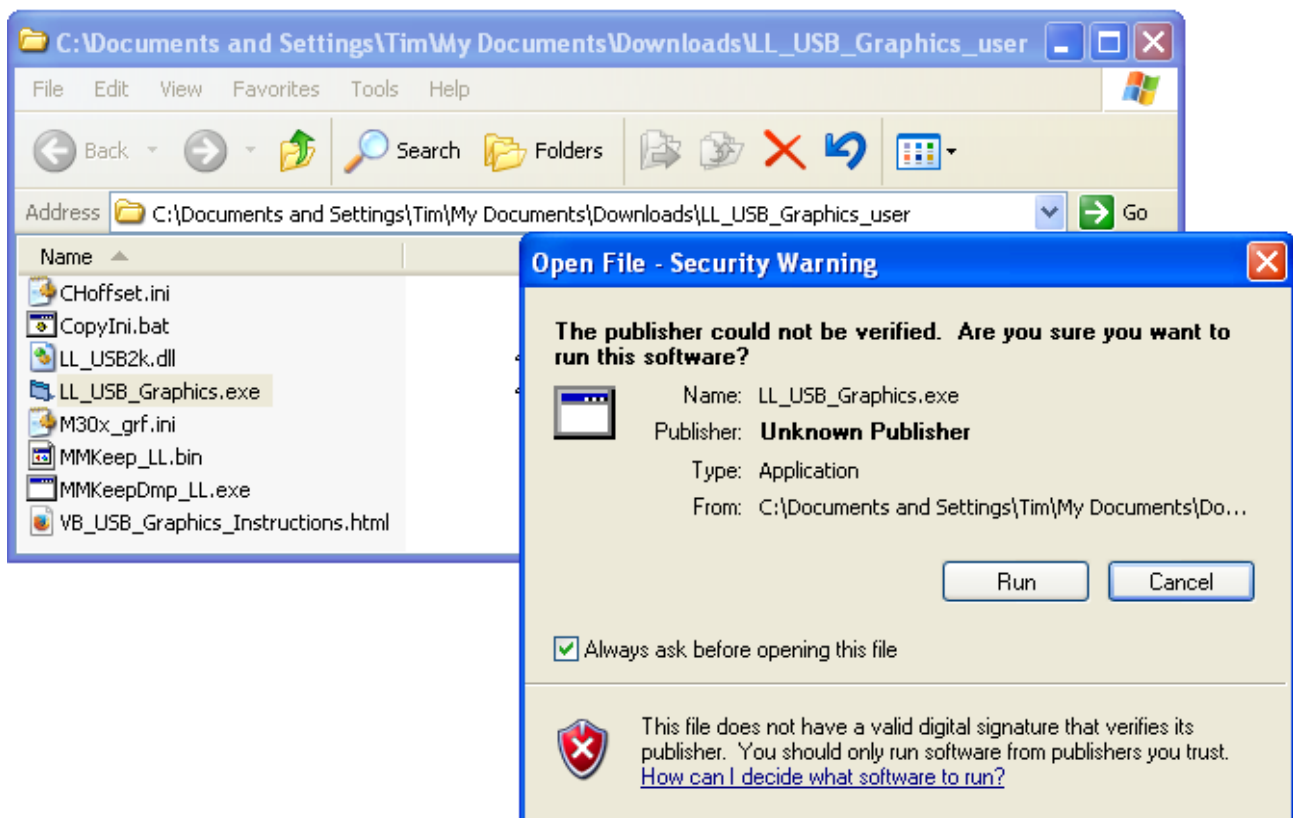
Click Finish, when done.



You should see these files in your application folder. The .html file is instructions. The LL_USB_Graphics.exe file is your application. The other files should take care of themselves.



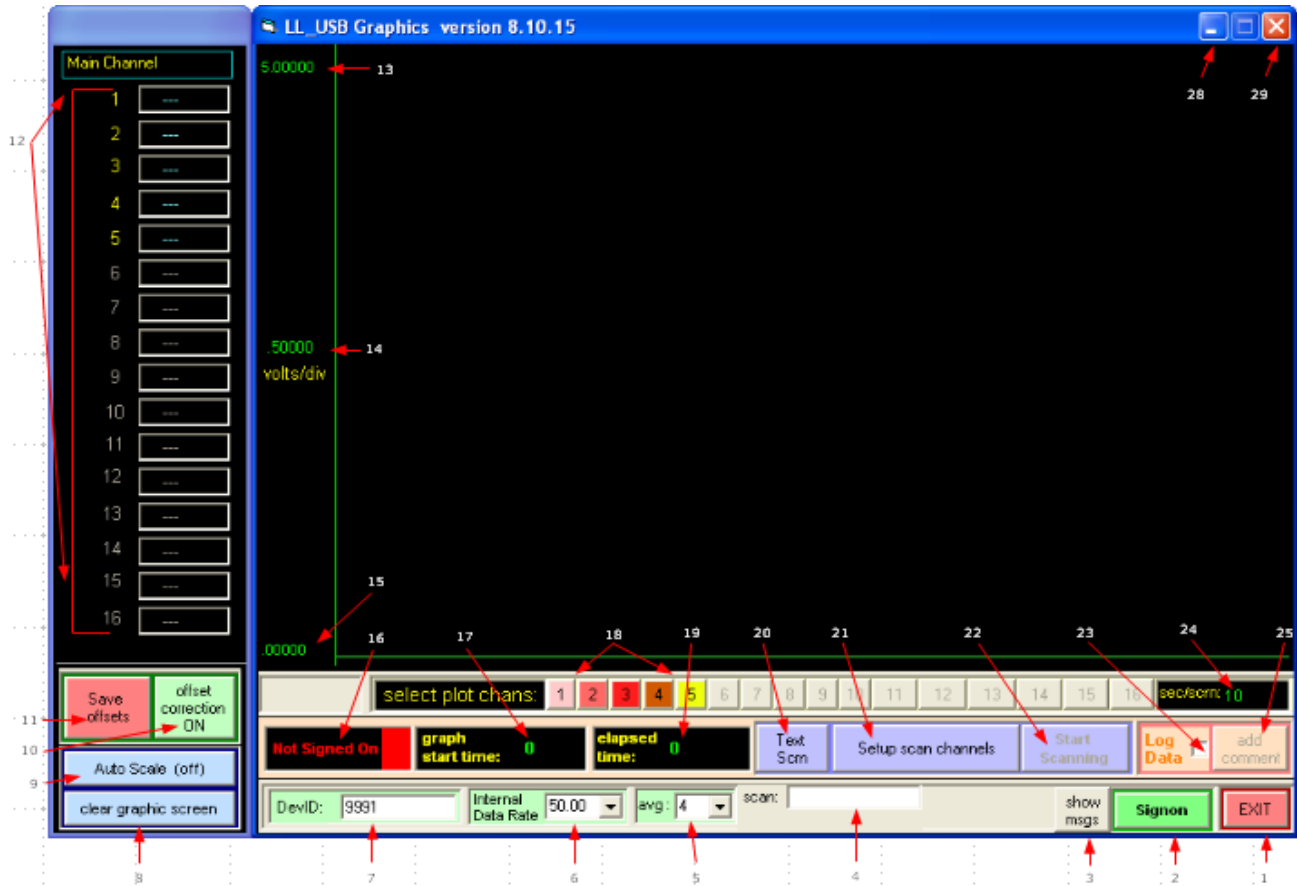
Right click on the LL_USB_Graphics.exe file and select Run as Administrator. If you see a security warning, click Run.



4 Operation

A. Location of controls

You should see the main panel on your screen. Controls and indications are numbered below, with a key for easier locating.



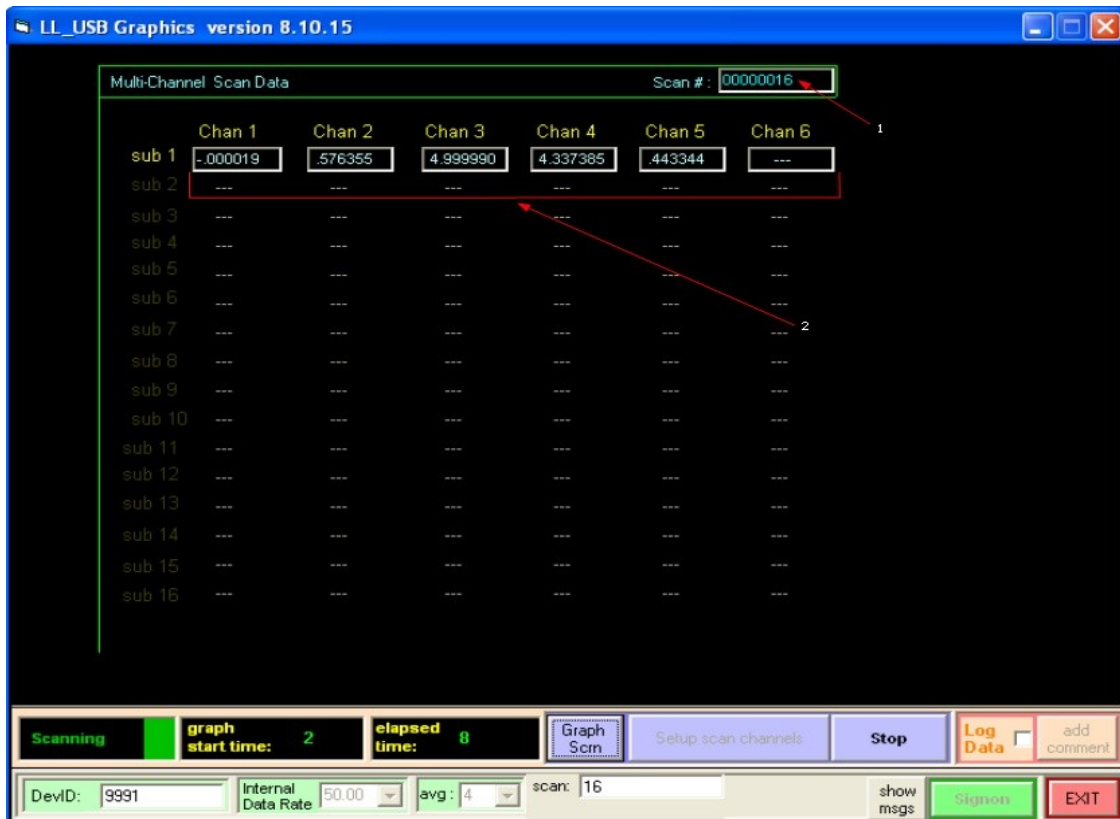
1. Click #1 or #27 to exit. You will be prompted to optionally save any changed settings.
2. Click to establish communications (only needed once per session).
3. If you fail to establish communications, click here for more information.
4. The scan number during acquisition is shown here.
5. You can enter any number between 1 and 128, or select from list. This is a running average so it does not affect your scanning rate. Higher numbers yield smoother data, but longer settling times.

6. The Internal Data Rate is crucial for noise reduction. Normally, it should be set to line frequency, either 50 or 60 Hz.
7. You must enter the Device ID number for your EMF unit here. The Device ID is found on the bottom of your instrument.
8. Click here for a fresh graphics screen.
9. Toggles Auto scaling for the vertical axis.
10. Toggles the application of saved offsets, if any.
11. Click to record the present voltages as zero volts. When these offsets are applied, the voltages on all channels will read zero. This step is normally only done once.
12. Data in volts is displayed here during a run. The EMF 2 will display up to 2 channels. The EMF 6 will display up to 6 channels.
13. Edit the positive full scale voltage here when Autoscale (#9) is toggled off. Must be greater than negative full scale (#15). Press Enter key to apply. Graph scale settings are saved for future sessions. Saved graph settings can be restored by stopping and restarting the scan.
14. Volts per vertical division. This number is calculated, and can not be edited.
15. Edit the negative full scale voltage here when Autoscale (#9) is toggled off. Must be less than positive full scale (#13). Press Enter key to apply.
16. Instrument status.
17. During a run, the elapsed time in seconds at the left-hand edge of the graphics screen.
18. Click a channel number to toggle whether this channel is plotted. Only channels selected in setup scan channels (#21) will be available. Adding or removing a channel from the plot does not change the scanning sequence or the data logging files. It does change the Autoscaling.
19. During a run, the total elapsed time, in seconds, since the start of the run.
20. Toggle between text and graphics display (does not affect data collection).
21. Click for setup panel, see below.

22. Toggles data collection. Click once to start, and click again to stop a run.
23. Check the Log Data box to save your data in a text file. You can uncheck and recheck the box as you like. The file will show data marked with the time since the start of the run so the time is preserved when data is not saved.
24. Enter the desired time duration for one graphics screen here and press the Enter key to apply. Ten seconds is the minimum period.
25. Click here to add a time-stamped comment in the right hand column of the data file.
26. Minimize
27. Exit

Not shown: A text display of the voltage and time at the cursor position will show near the vertical axis.

B. Text Screen (#20 above)



1. Scan number
2. Up to 6 data points are displayed

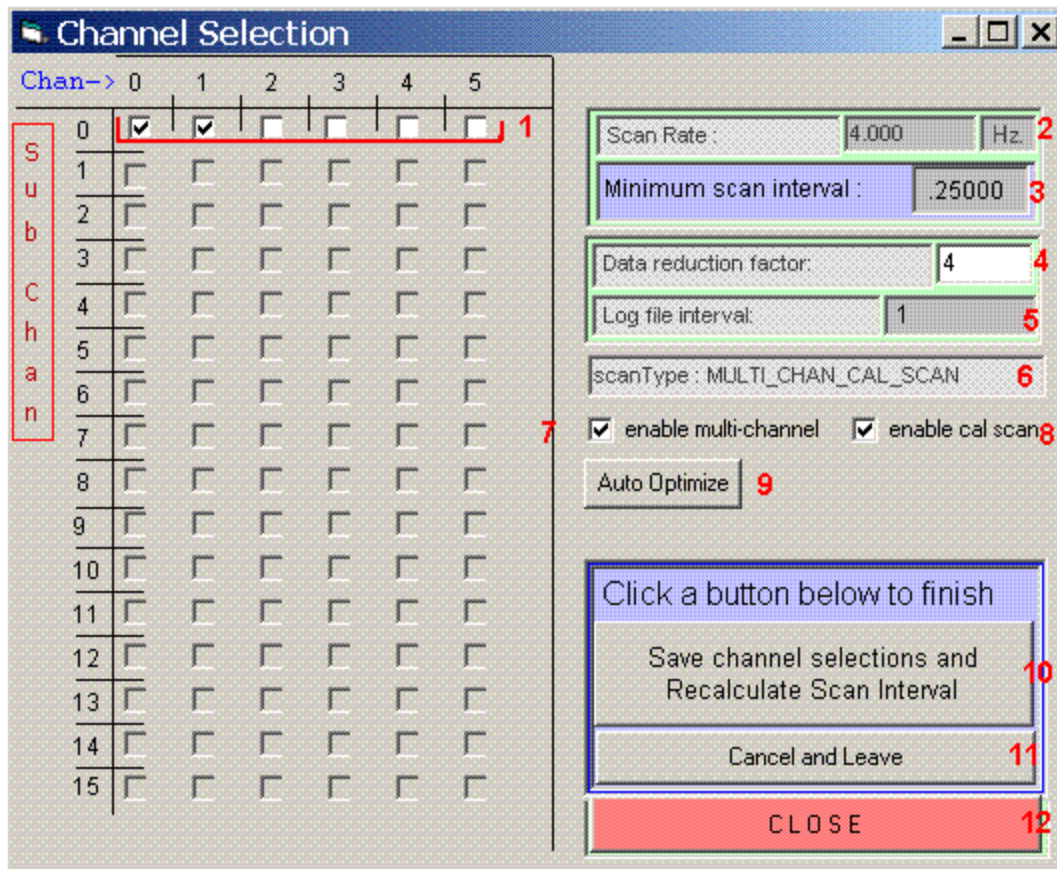
Click the "Graph Scrn" button to return to the main panel

C. Basic Operation

1. Start the software by right-clicking and selecting "Run as administrator". That should only be necessary the first time the software is run so that it can self-install.
2. Enter the Device ID number in the lower left. Every device has a unique iD. The Device ID is found on the bottom of your instrument.
3. Set the internal data rate to 50 or 60 Hz to match your line frequency.
4. Change the running average, if desired. The default is 4.
5. Click the Signon button to establish communication. The Status indication should show Ready.
6. Define your data collection as described in Scan Setup, below.
7. Click Start Scan to begin data collection, and Stop Scan to end.

D. Scan Setup

Click Scan Setup to bring up the Misc scan setup screen.



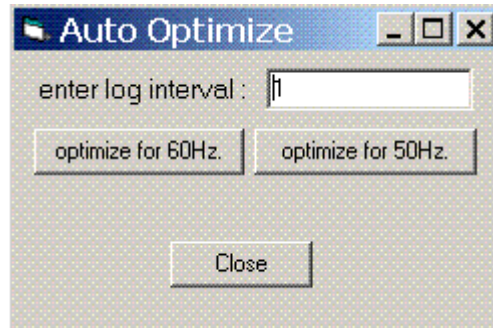
1. Check adjacent boxes to include channels in a scan. The enable "multi-channel" box (#7) must be checked in order to scan more than one channel. For fastest multi-channel acquisition, begin with channel 1.
2. The Internal Data Rate is shown here for reference. To change the Internal Data Rate, enter it on the main panel, #6.
3. The Minimum scan interval in seconds is calculated from the Internal Data Rate and the number of selected channels. Your screen will attempt to update at this interval during a run.
4. With data reduction set to 1, each scan interval will record as a line in your data file. To reduce the size of your data files, any integer number of scan intervals can be block-averaged for each line in the data file. Here, the scan rate is 4 Hz and the data reduction factor is 4, resulting in data being saved at a 1 Hz rate. If set to 240, data would be saved once a minute.
5. The log file interval in seconds is displayed here. Change #4 above to change the interval.

6. Single and multi-channel scans are now supported. Toggle by checking/unchecking box #7.

7. Toggle scanning mode- In single-channel mode, data arrives from the selected channel at the Internal Data Rate. In multi-channel mode, acquisition is slower to allow for channel changing and settling times.

8. Toggle calibration scanning mode- In cal scan mode, a zero reading is taken once each scan and subtracted from the other channel readings. The effect is to remove any offset drift from the data. The cost is a slight reduction in the maximum scanning rate.

9. Auto Optimize will reconfigure your Internal Data Rate and Averaging factor to produce a scanning set up that will maximize rejection of line frequency noise, either 50 or 60 Hz.



Noise from the AC line can appear in your data as random noise, or may appear as a sinusoidal error over a wide range of frequencies. Because of a phenomenon called aliasing, AC line noise can appear as a sine wave with a period of many seconds. See the Application Guidance link for a white paper about reducing noise in high resolution data systems.

There are three internal choices for each type of scan, one slow, one medium and one fast. The slow scan will set the Internal Data Rate to match the line frequency. That will result in excellent line frequency rejection. Request a log interval long enough to allow an Internal Data Rate of the line frequency to obtain best noise rejection.

The fast scan will run at the maximum rate possible, consistent with line frequency rejection. Set a very short requested interval for fastest operation. The scan settings chosen by the optimization will use the lowest Internal Data Rate that can achieve the log interval requested. Only some rates are available, so the log interval will often be an approximation of the interval requested.

For optimized multichannel scans, the optimized averaging factor is important. You can always double it for more filtration, but other values may destroy the line frequency

rejection entirely.

If you change the scan type or number of active channels, you will need to re-optimize your scan for line frequency rejection.

Note: If you see unexpected noise, check that you are optimized for the correct line frequency.

10. Click Recalculate to see the result of any changes.
11. Click Cancel to leave setup without saving any changes.
12. Click Close to save and return to the main panel.

E. Offsets

1. Each EMF channel has its own small offset associated, typically less than 1 mV. These offsets can be stored and used to cause each channel to read zero when the input is shorted. To create an offset file, begin a scan with all inputs active and electrically shorted using the terminator plugs provided. Put the ground switch, or jumpers, in the SAFE position. After a few minutes, click Save Offsets. You will be prompted to confirm, since the old offsets will be lost. Afterward, when Use offsets is selected, all readings will be very near zero.

2. Thereafter, those offset corrections will be stored and available each time you start your software. For corrected or uncorrected data, toggle the Use offsets button.

NOTE: If you save offsets without zero volts applied, or with floating input channels, or without a ground connection, subsequent data may be drastically shifted. You can always turn off "apply offsets" to confirm uncorrected data.

3. Earlier versions of this software saved the Offset file in the Windows folder. That could cause user access control issues and confusion due to virtualization. It could also cause multiple instances of the software to interact. From December 2016 onward, the offset file is saved in the application folder. The change is backward compatible, that is, running the newer version will retrieve your original offsets and save them locally.

F. Data Files

The data files are placed in the working directory and are named using the starting date and time. For example, the file shown below is named "8-14-2015_13.56.19.txt". A new file

is created for each Start Scan. Checking and unchecking the Log box during a scan will result in gaps in your log file. Note that the first column in the file shows the time in seconds since beginning the run. Data is in volts. Below is a sample 3-channel data file recording at a 1 second interval. Logging was turned off between 12 and 24 seconds.

NOTE: Depending on your computer's User Access Control settings, the data files may appear in your VirtualStore path.

```
8-14-2015_13.56.19.txt - Notepad
File Edit Format View Help
Time / s      [chan 1]      [chan 2]      [chan 3]
0000001.0    -.000012     1.345862     -.000002
0000002.0    -.000008     1.345860     .000000
0000003.0    -.000010     1.345859     .000003
0000004.0    -.000003     1.345866     .000006
0000005.0    -.000003     1.345864     .000007
0000006.0    -.000005     1.345862     .000003
0000007.0    -.000009     1.345863     -.000003
0000008.0    -.000015     1.345864     -.000006
0000009.0    -.000015     1.345869     -.000006
0000010.0    -.000010     1.345873     -.000000
0000011.0    -.000010     1.345848     -.000002
0000012.0    -.000010     1.345842     -.000001
0000024.0    -.000020     1.333496     -.000014
0000025.0    -.000021     1.346053     -.000012|
0000026.0    -.000022     1.346058     -.000010
0000027.0    -.000020     1.346059     -.000006
0000028.0    -.000015     1.346059     -.000009
0000029.0    -.000017     1.346058     -.000007
0000030.0    -.000018     1.346050     -.000009
0000031.0    -.000018     1.346054     -.000006
0000032.0    -.000014     1.346060     -.000007
0000033.0    -.000015     1.346057     -.000005
0000034.0    -.000018     1.346057     -.000003
0000035.0    -.000018     1.346060     -.000003
0000036.0    -.000015     1.346064     -.000002
0000037.0    -.000014     1.346063     -.000005
0000038.0    -.000019     1.346057     -.000007
0000039.0    -.000017     1.346059     -.000004
0000040.0    -.000014     1.346058     -.000006

Averaging:      4
Internal Data Rate: 60
Number of Scans: 160
Started:        8/14/15, 1:56:17 pm
Finished:       8/14/15, 1:56:57 pm
```

5 Troubleshooting

A. Can't connect

1. Wrong ID number?

Double check that the number on the bottom of the instrument case matches the number in the DevID box.

2. Is there a duplicate application open, or another program that talks to the same instrument?

You cannot share the instrument between open applications. The first program will own it, and will block out all other applications.

3. Was there a recent software lock-up?

If an application accessing the instrument is not allowed to close properly, you may need to reboot the computer to regain the USB connection.

4. Double check cable and power.

If everything else looks right, use the Device Manager and select Hardware, Then view the USB section. You should see a Lawson Labs device in the list marked as working properly. If you do not, refer to the hardware installation, Section 2 above.

B. Noisy data

1. The internal data rate should match your line frequency, or use Auto optimize for the correct line frequency.

2. Are terminators in place on unused channels? Open channels can cause increased noise.

3. The EMF 6 has a thumbscrew on the back panel for earth grounding. The EMF 2 has screwdriver terminals labeled G for Ground for that purpose. A wire from Ground to a water pipe or ground rod ground may improve noise rejection and should not cause a ground loop.

4. There may be another grounding issue. There should be one, and only one ground per solution. No ground will cause problems, and duplicate grounds will form ground loops.

See the next section for a grounding discussion.

C. Wrong data

First, turn offset correction off. Voltages should be correct to within a millivolt or two. If turning off offset correction fixes the problem, redo your offsets. See Section 4 E.

Otherwise, wrong data is usually due to input connection problems.

First, make certain all inputs are connected to intact electrodes, or are shorted with terminators.

Check the grounding switch on the EMF 6 or the ground jumpers on the EMF 2. The SAFE position is a good place to start. For optimum performance you will want to use the DIFF position for true differential inputs. Three wires are needed for true differential. Those are + in, - in, and ground. Only the instrument input current should flow in the + and - wires. Any ground current will flow in the third wire.

Optimal connections, true differential:

One and only one non-critical connection from each solution to Ground at the instrument.

Reference electrode to REFERENCE input (minus in)

Working electrode(s) to positive input(s)

Next best:

Without the solution ground wire, use the SAFE switch (or jumper) position.

NOTE: Look at *all* your input channels. If any one channel is driven outside the specified input range, other channels may read incorrectly.

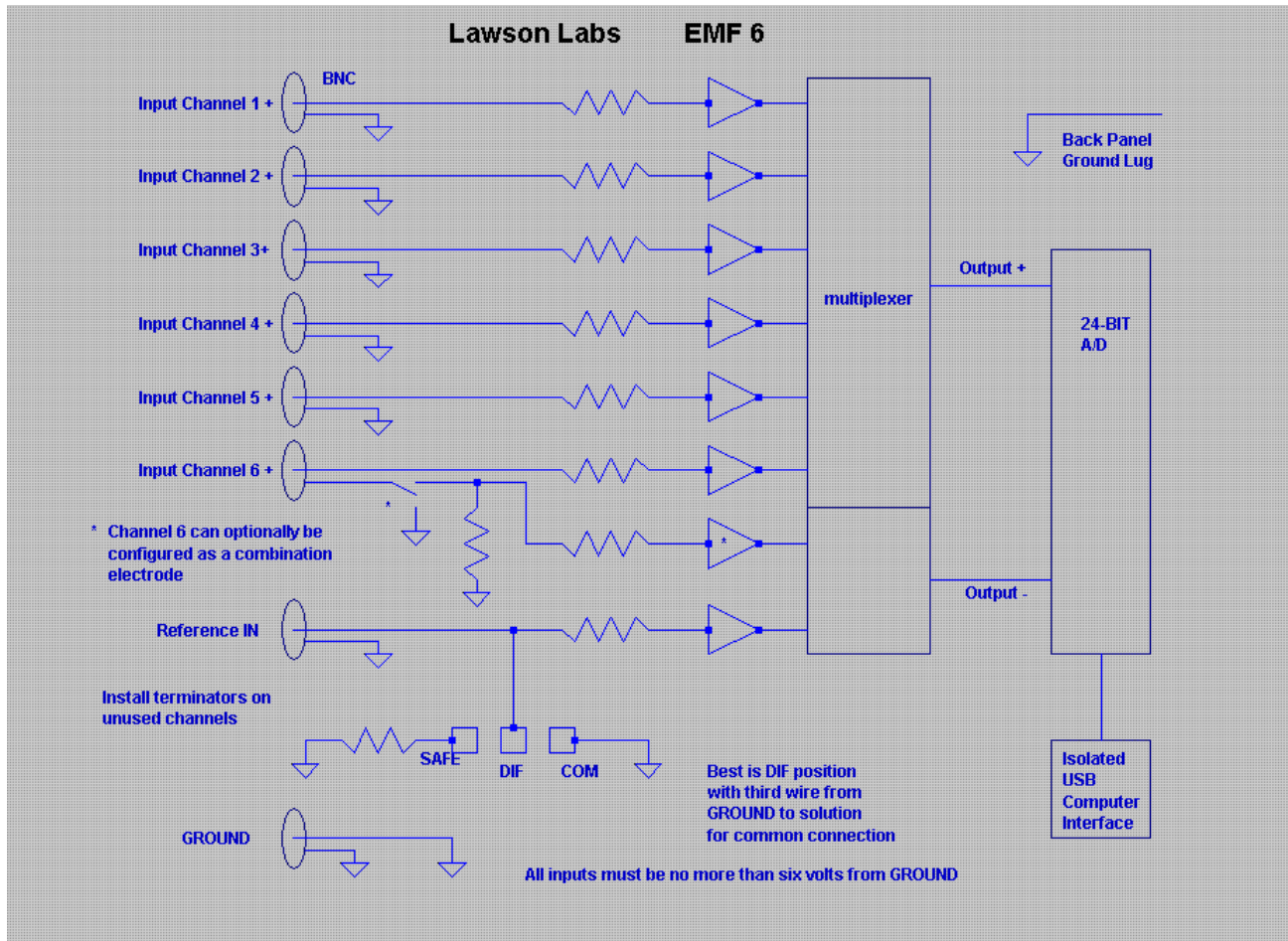
D. Occasional large data excursion, say, twice a minute to twice an hour.

Usually means missing ground connection. See above.

E. Step changes at erratic intervals, sometimes followed by long settling times.

This is the classic ground loop symptom. Step changes may correlate with HVAC or with cycling of other equipment. Locate and remove the redundant ground connection.

EMF 6 BLOCK DIAGRAM



EMF 2 BLOCK DIAGRAM

