Mobile Studio Desktop: Setup and Calibration

Purpose

Mobile Studio Desktop provides the equivalent of a number of bench-top electrical instruments in the form of software on a personal computer. The purpose of this Introduction is to tell you a little about MSD, walk you through setting it up on your laptop, and have you try a couple of its functions.

A Brief History

Mobile Studio Desktop grew out of an idea of Professor Don Millard, an idea that good electrical laboratory pedagogy could be accomplished by using computer representations of typical laboratory instruments plus computer interface boards to connect to actual electrical devices and circuits.

Professor Millard and his graduate students began to develop this idea at Rensselaer Polytechnic Institute. As the project expanded, he obtained financial support from the National Science Foundation and involved four other schools: Howard, Morgan State, Rose-Hulman, and SUNY Albany.

The concept is simple: Use a computer as the instrument, provide an interface board to connect electrical devices to the computer through the USB port, and manipulate the virtual instruments just as one would use real instruments on a lab bench—but at a much lower cost. Figure 1 shows a complete set-up with a small circuit attached to it.

Equipment

We'll use Mobile Studio Desktop in a number of the labs in this course. Here's what that takes:

- An Intel-based computer, either desktop or laptop with a USB 2.0 port, running Windows 2000, XP (except x64), Vista, or Windows 7. This includes Intel-based Macs running Windows either under OS X and Parallels or stand-alone via Boot Camp.[1]

- The current version of Mobile Studio Desktop. See the next section for how to get this.

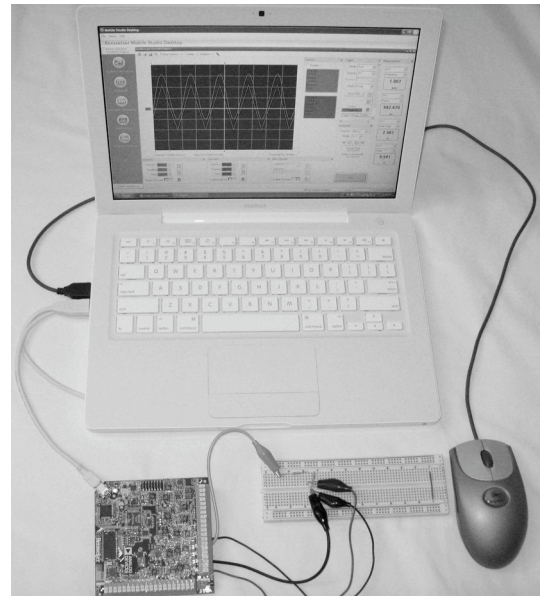- The current Mobile Studio IOBoard™ and the appropriate USB cable.

Fig. 1–Complete MSD setup

A word of warning! The I/O board is powered by your computer's USB port. The circuits you build will be connected to the board and will derive power from it. Don't short-circuit any power connections from the I/O board! It is possible to destroy the board and, under the right (wrong?) conditions, your USB port.

Installing Mobile Studio Desktop

Before downloading Mobile Studio Desktop, you must disconnect any I/O board from your USB port. Don't connect the board until you have MSD running on your computer.

You *must* be in **administrator mode**. Then go to `http://www.mobilestudioproject.com` and click on the "Software Download" button.

After downloading, go through the license and installer screens. If you get a security warning, allow installation to continue. If you are asked to allow installation of .NET or National Instrument software, allow them—they are needed for MSD to run.

Now stop here until you have an IOBoard to connect.

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[1] I have not been successful on the Mac with Fusion or VirtualBox. Parallels is slow.

Connecting the I/O Board

Once installation is finished, and you are still in *administrator mode,* connect your I/O board. If you get a notice of a need for drivers, follow the Add New Hardware instructions, choosing "No" on the first screen and then accepting all defaults. You also may get a request to update the board's firmware before the board will work properly. Go to the Device menu and follow instructions.

You also might get a message that this board is not "calibrated." What this is really saying is that your computer does not know the settings for reading data precisely from the board you've connected. If you don't get a message about calibration, skip to *Now Let's Play!*

Calibration

Choose to calibrate now. Someone may already have generated the calibration file for this board (a .ioc file):

1. Go to `http://ece-1.rose-hulman.edu`

2. Then `ECE Downloads --> Mobile Studio`

3. Look for your board (`R2nnn.ioc`).

4. If it's there, download the file to your desktop—if it isn't, skip to *Manual Calibration.*

5. In Mobile Studio, `Device -> Analog Calibration`, click "load from file," locate the newly-downloaded file, and load it.

6. Your computer now knows about (and will remember) this particular board. Discard the .ioc file and skip to *Now Let's Play!*

Manual Calibration

If you didn't find a calibration file, your board needs calibration. It's not hard to do but it requires close attention to detail. The only instrument you'll need is your digital multimeter.

Please calibration carefully! Your file will be available to other MSD users.

Figure 2 is the arrangement of the connections on the IOBoard. Calibration requires measuring and adjusting voltages at some of the terminals and then using these output ports to automatically calibrate the input ports.
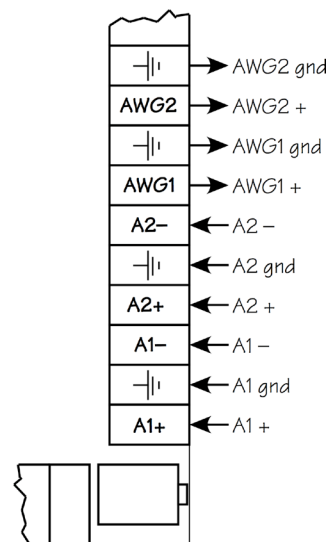

Fig. 2—Red2 terminals

The initial calibration sets the Gain and the Offset of AWG1 and then repeats the procedure for AWG2:

1. Close any instruments that are on your screen.

2. Launch Analog I/O.

3. Connect your digital multimeter to the AWG1 terminal and its ground. See Fig. 2.

4. Set Analog I/O's Analog Out Ch1 to 3.000 V.

5. Select DEVICE –> ANALOG CALIBRATION.

6. In "calibration settings," select "channel 1." (It probably is already.)

7. On the "AWG output" line, adjust "Gain" to get the DMM to read 3.000.

8. In Analog I/O, change Analog Out Ch1 to **−**3.000 V.

9. Note the DMM's reading. Calculate the mean between this number and –3.000. For example, if the reading is –3.227, the mean value is –3.114 V.

10. On the "AWG Output" line, adjust "Offset (SE)" to get the DMM to read the value just calculated.

11. On the "AWG output" line, adjust "Gain" to get the DMM to read –3.000 V.

12. Change Analog Out Ch1 to **+**3.000 V.

13. Check the DMM, which should read 3.000 V. If it doesn't, split the difference and return to Step 7.

14. Repeat Steps 3 through 13 for AWG2 with the following differences:

    a. Connect the DMM to AWG**2** and its ground.

    b. Set Analog I/O's Analog Out Ch**2** as directed.

    c. Make all calibration adjustments on "channel **2**."

This completes manual calibration. Now we'll have Mobile Studio automatically calibrate the inputs A1+/– and A2 +/–.

1. Close Analog I/O.

2. Connect AWG1 to A1+ and AWG1's ground to A1–. (See Fig. 2.)

3. Connect AWG2 to A2+ and AWG2's ground to A2–.

4. Near the bottom of the Analog Calibration screen, click the "auto-calibrate A1" button. Calibration could take as long as a minute.

5. Similarly, click the "auto-calibrate A2" button.

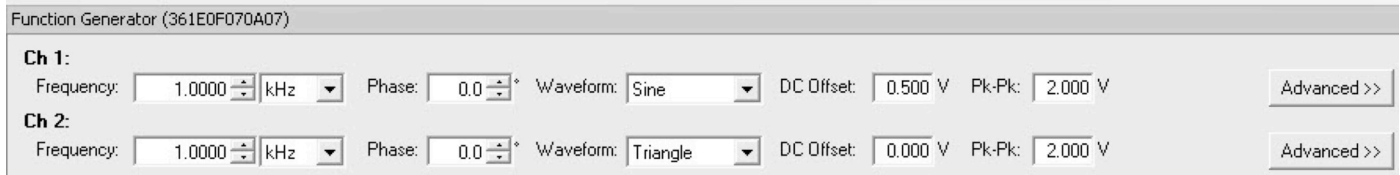That finishes calibrating everything. Now make it available

Fig. 3—Function generator screen

to others. Click "save to file" and save the calibration file on your desktop with your IOBoard's name: `R2nnn.ioc`. Then e-mail it to `crosby@rose-hulman.edu` to have it included on the ECE web site.

It's time to try Mobile Studio Desktop.

Now Let's Play!

You've installed your software, connected your I/O board, and calibrated it so that your computer knows how to precisely display data from the board. It's time to play with a couple of instruments without connecting anything to the I/O Board.

I'm going to walk you through some simple exercises to try out the instruments. I'll use a few screen shots, but don't be surprised if your screen differs a bit from mine. The MSD software is continually being updated and screens change from time to time.

I'll assume that you have MSD running, an I/O board connected and calibrated, and a display of icons for several instruments on the left. (For the record, the Mobile Studio folks call these *devices*, not instruments.) Let's start with the Function Generator device.

Function Generator

1. Click on the FUNCTION GENERATOR icon.

2. Change the settings for Ch 1 and Ch 2 to match those shown in Fig. 3 above.

3. Note that Ch 1 has a d-c offset of 0.5 V and Ch 2 is a triangle waveform.

4. Locate the small pushpin icon in the upper right corner and click on it to get the Function Generator to become a tab near the bottom of the screen.

5. Mouse over the Function Generator tab at the bottom of the working area and note that the settings pop up. Moving the mouse out of the Function Generator sinks it from sight.

Oscilloscope

1. Click on the OSCILLOSCOPE icon.

2. Set Channel 1 to 500 mV, DC coupling, and AWG1 input. (AWG1 is both the Arbitrary Waveform Generator and the Function Generator.) See Fig. 4 below.

3. Enable the channel by clicking the switch to the left.

4. Set up and enable Channel 2 the same way, except that the input is to be AWG2.

5. Set up Trigger (upper right) for Auto, Ch1, Rising, 500 µs/div, Y-T.

6. Click on the red Start button near the bottom right of the screen

Your MSD screen should look like Fig. 5 on the next page.

The End

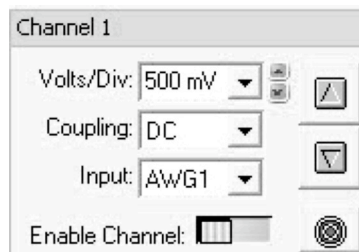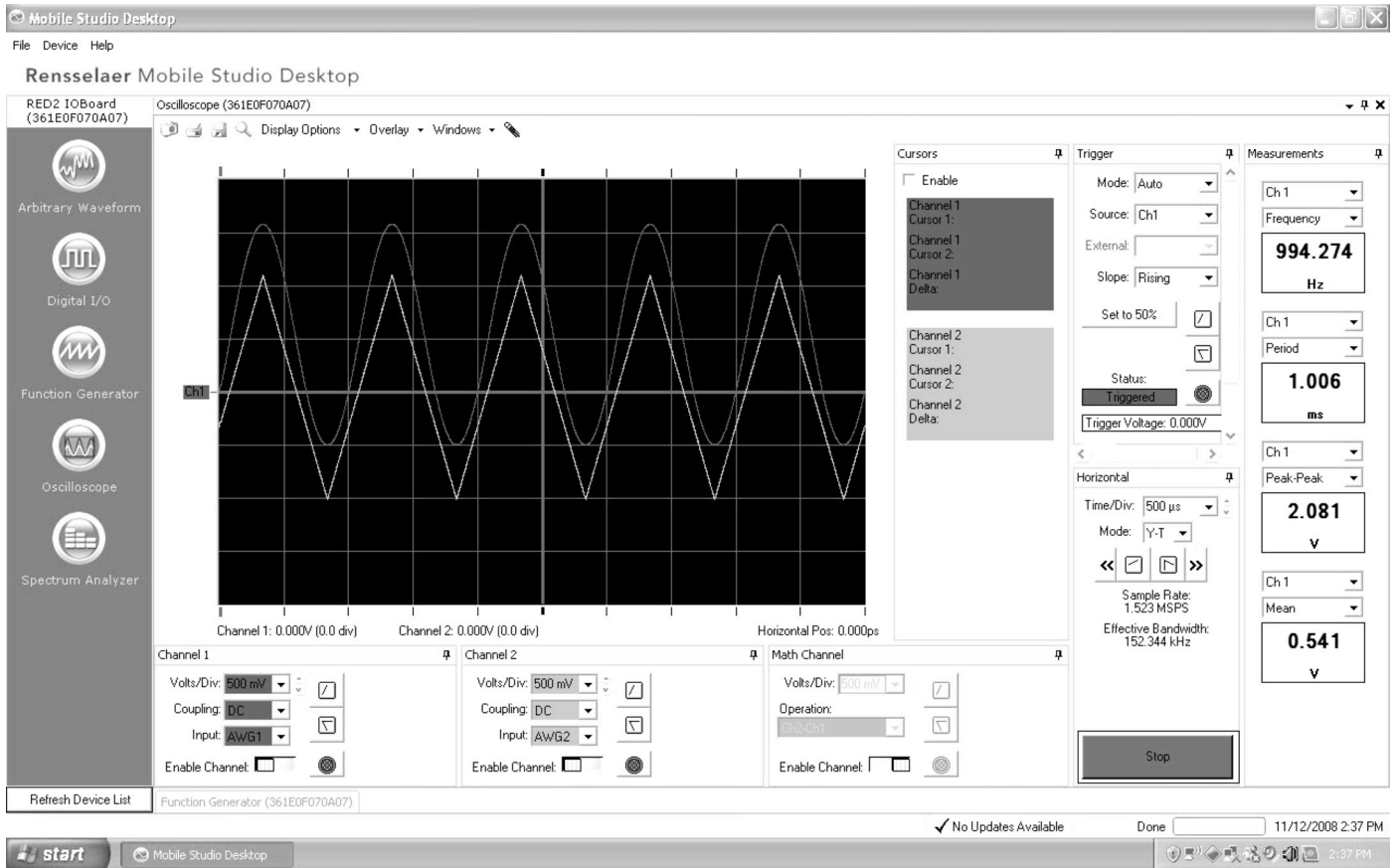Now Mobile Studio Desktop is set up and calibrated and you are ready to begin using it.

Fig. 4—Scope channel screen

Fig. 5—Overall MSD screen