Testing LI6400TermHD for iPad

Version 2.0.0

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Contents

Background

The LI-COR LI-6400XT is a scientific instrument used to measure photosynthesis and other physiological parameters of plants. It has been available for nearly 20 years, and has become the world-wide standard for this type of measurement.

The iOS app LI6400TermHD allows an iPad to control the LI-6400, providing the same user interface on the iPad as the user sees on the instrument, plus a number of enhancements.

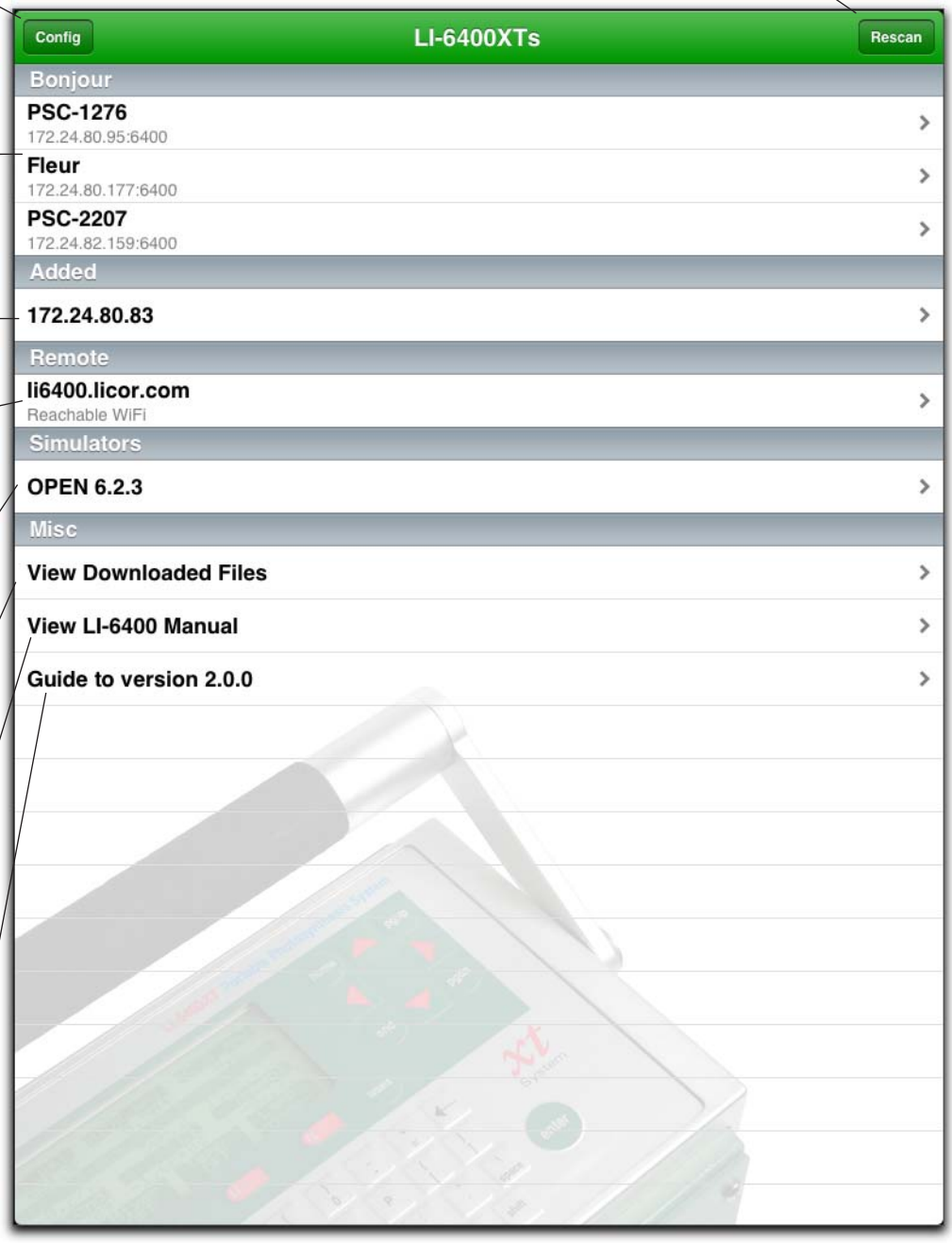
Version 1 of this app has been available since Nov. 2010.

Version 2 of this app, which you are testing, adds some features:

- replaces the custom keypad with the iOS keyboard, plus some toolbars with LI-6400-specific keys.
- allows file transfer between the LI-6400 and the iOS device.
- allows files to be viewed, plotted, and emailed.
- adds a built-in LI-6400 simulator, useful for learning, testing, etc.
- adds several auxiliary support views, including real time graphs and viewing the operating manual.

The App's Main Screen

LI6400TermHD's main screen is shown below.



Manually enter IP address, enable instrument simulator.

Re-scan for LI-6400XTs on LAN.

LI-6400XTs discovered on the LAN to which the iPad is currently joined.

Manually added address, via Config.

Connect to an LI-6400 via our server. See "Option 1 - Use li6400.licor.com" on page 3

LI-6400XT Simulator, enabled via Config. See "Option 2 - Use a Simulator" on page 4

This is the local portion of what is described in "Files" on page 13

Complete LI-6400XT Operating manual. Similar to what is described in "Manual" on page 21, but from this context, this is no display for a connected instrument, since none is connected.

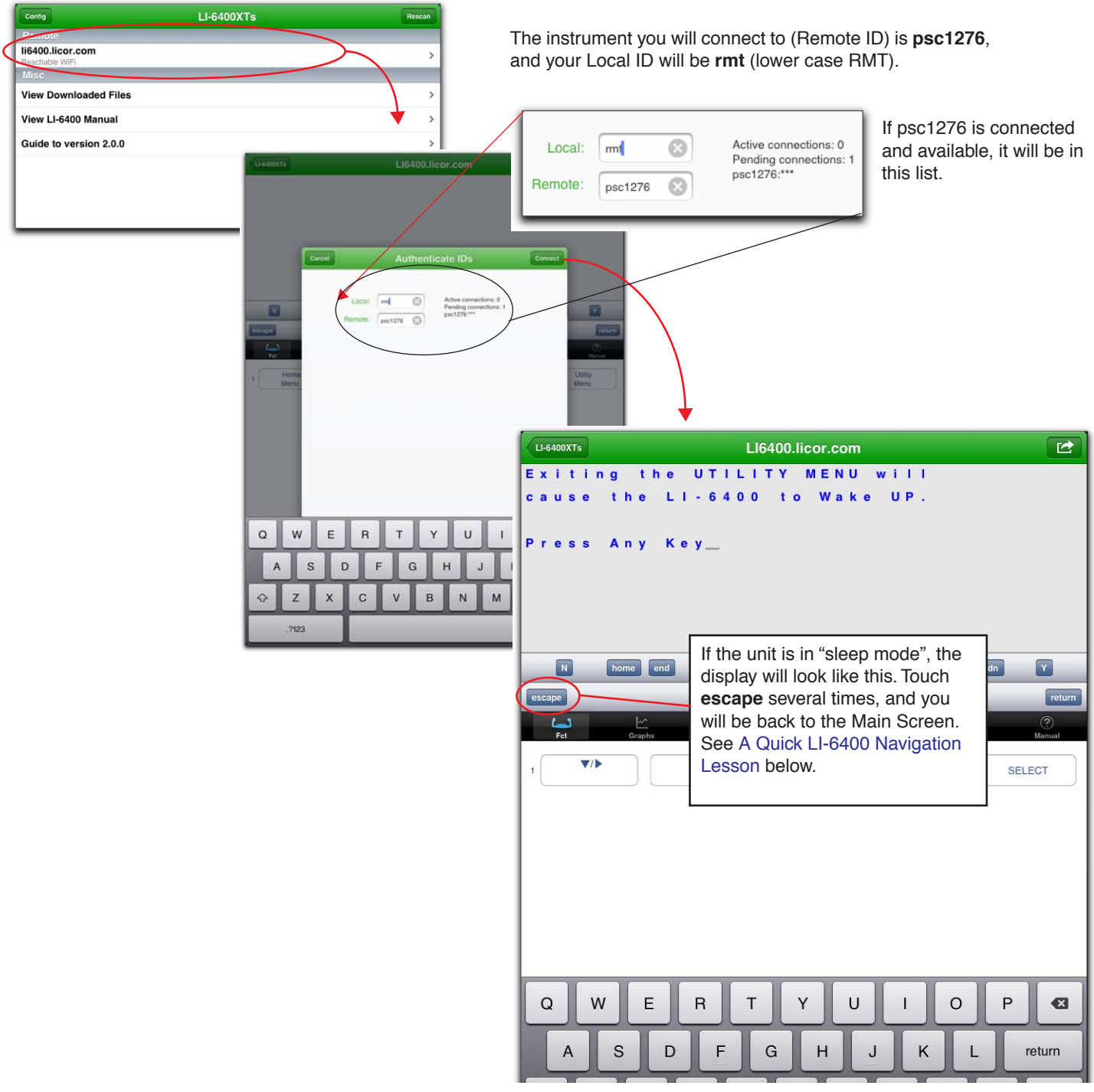
Users guide for this App. Uses the same interface as described in "Manual" on page 21.

Options for Testing

Since it is not likely you have an LI-6400 with which to test this app, there are two options: 1) connect to an actual instrument using a server (li6400.licor.com) as was done the first time, or 2) use the built-in simulator. The simulator runs in a separate thread, and it communicates with the main view controller in the same manner as with an actual instrument.

Option 1 - Use li6400.licor.com

The figure below shows how to connect through the server. If you contact me (jon.welles@licor.com) prior to testing, I will be sure a unit is connected for you to use.



The instrument you will connect to (Remote ID) is **psc1276**, and your Local ID will be **rmt** (lower case RMT).

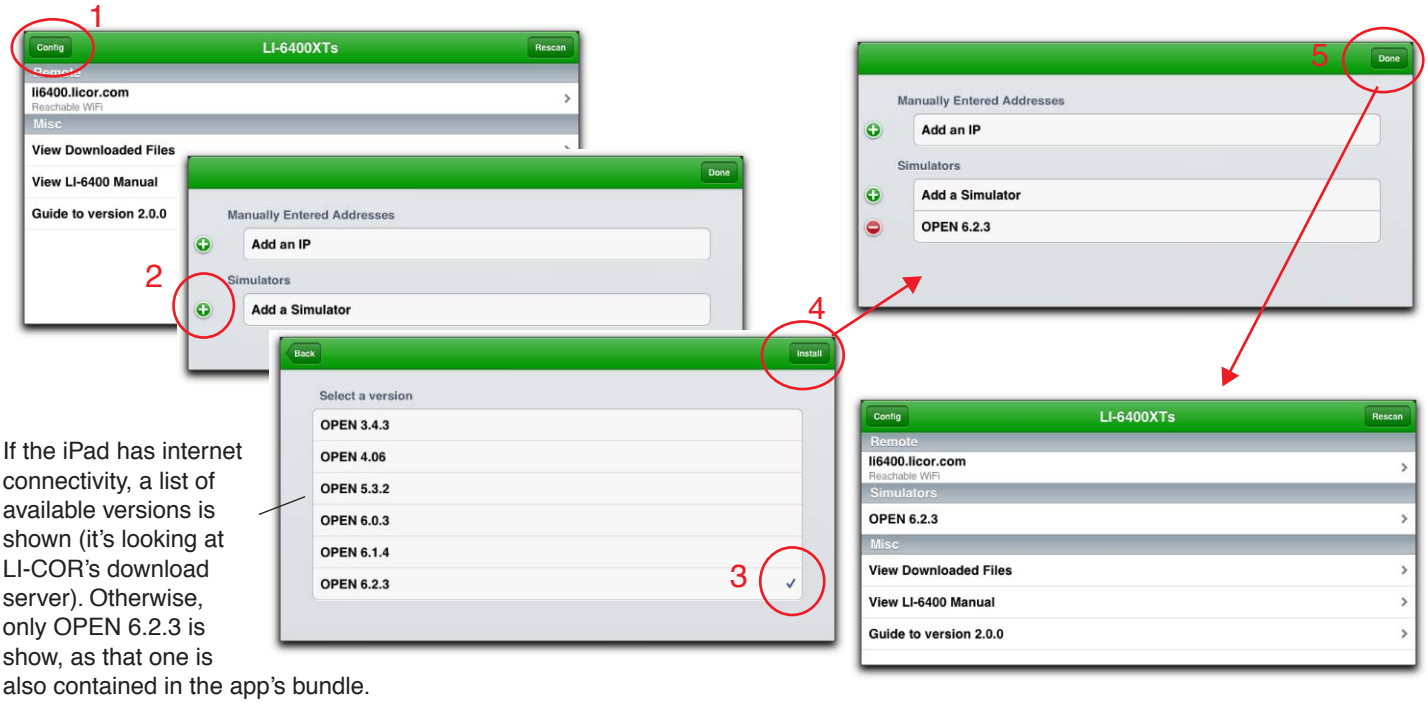
If psc1276 is connected and available, it will be in this list.

If the unit is in "sleep mode", the display will look like this. Touch **escape** several times, and you will be back to the Main Screen. See A Quick LI-6400 Navigation Lesson below.

Option 2 - Use a Simulator

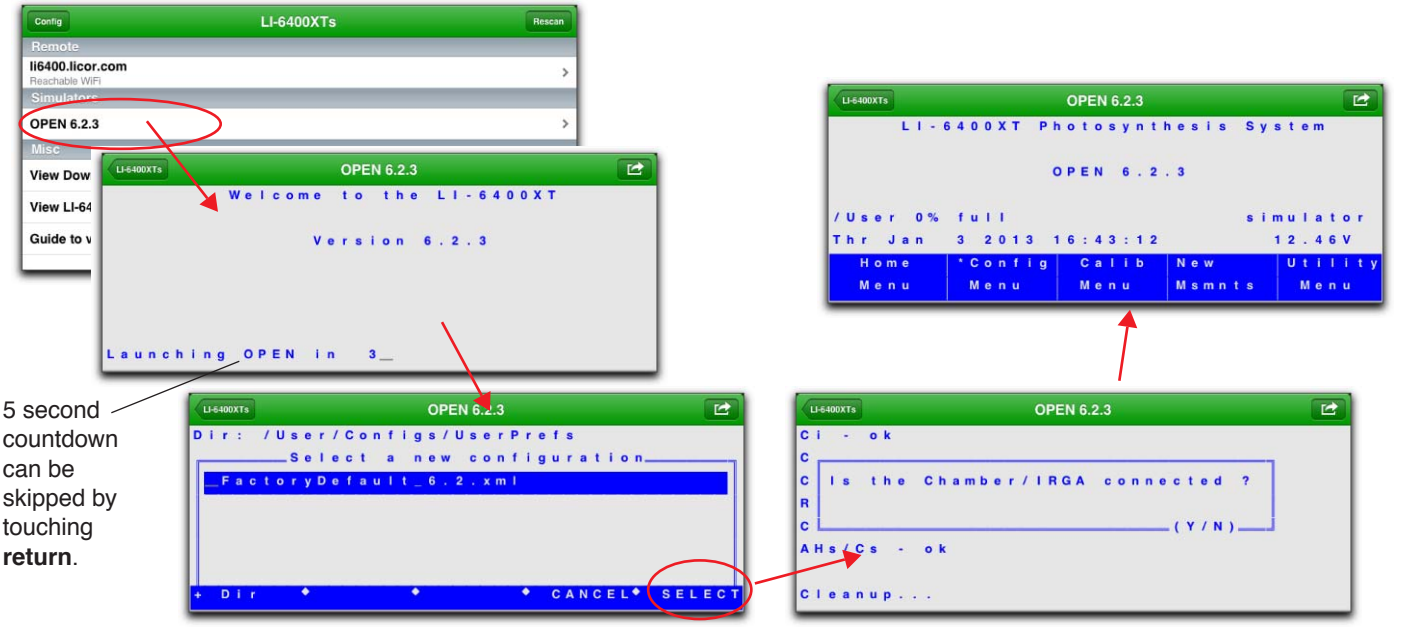
LI-6400 programming is done in a home-made scripting language (LPL). LPL has been ported, over the years, to DOS, Windows, Linux, Mac 9, OS X, and now iOS. The collection of script files that defines any given version of OPEN (the name of the software on the LI-6400) can run unchanged on any of these operating systems. The OS in an LI-6400 is embedded Linux.

To “install” a simulator (i.e. to unpack the collection of script files and copy them to the app’s Document directory), start with the Config button in the app’s main screen.



If the iPad has internet connectivity, a list of available versions is shown (it’s looking at LI-COR’s download server). Otherwise, only OPEN 6.2.3 is show, as that one is also contained in the app’s bundle.

Running a simulator begins a bit differently than connecting to an instrument, since the simulator starts at “power up”. Basically, if you are asked something, either press **return** or, if it is a y/n, press **y**.



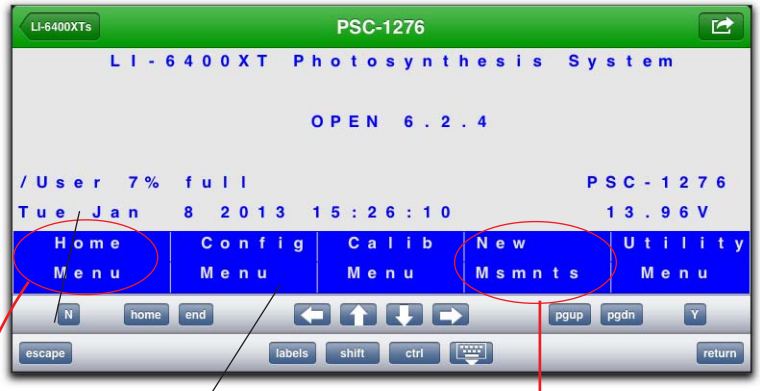
5 second countdown can be skipped by touching **return**.

Miscellaneous Information

A Quick LI-6400 Navigation Lesson

Below are OPEN's main screen, New Measurements mode, and an example Menu.

Main Screen



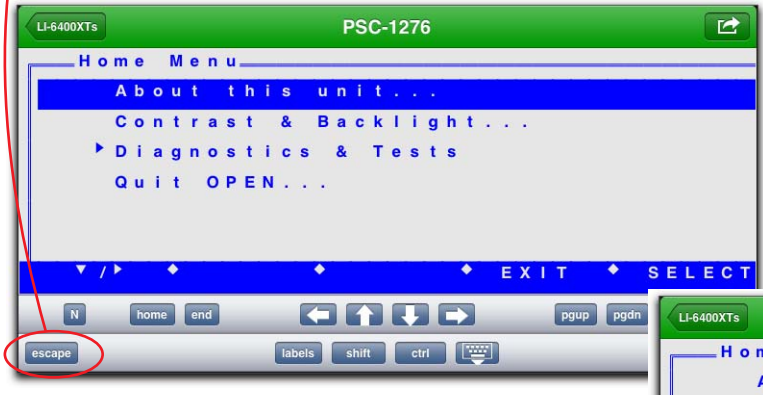
Gestures supported by the simulated LCD:

Touch (in a fct key label): executes that fct key
Pan Up, Down - 1 up or down arrow key generated for each row height panned.
Pan Left, Right - 1 right or left arrow key generated for each character width panned.

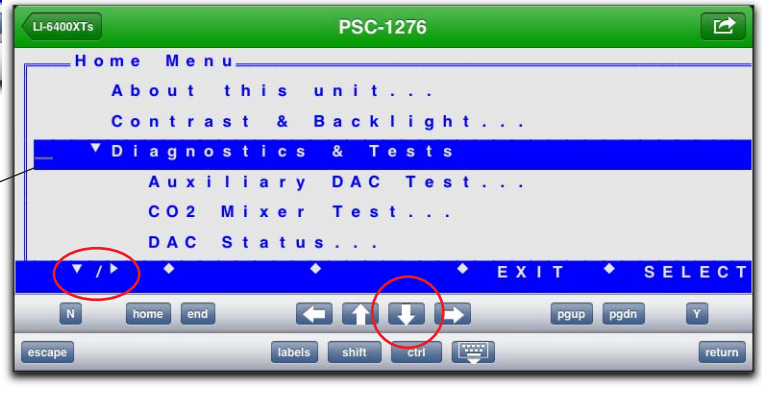
Function Key labels at the bottom of the simulated display act as buttons in the app, and are the main way to get around. Use **escape** to back up.

New Measurements Mode

Home Menu



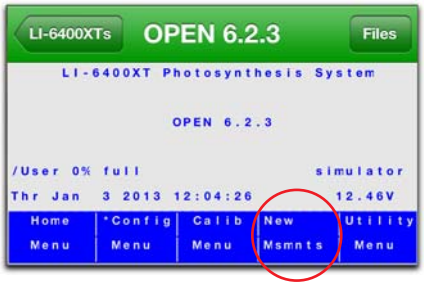
Menu navigation: To open a parent node in a menu, move the highlight bar to it (two down arrow keys, or pan down two rows), then touch the node toggle key, Fct key 1.



How to Create a Data File

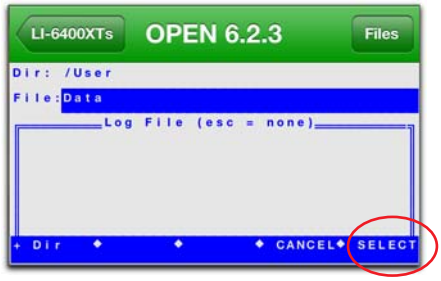
One of the new features of this app involves viewing and plotting data files. If you are using the simulator, you will need to create a data file to play with, and the step-by-step is below. If you are connected to psc1276, it already has data files on it you can use; but feel free to create additional ones with this method.

(The first 6 screen shots are actually from the iPhone app, but it is all the same for the iPad app.)

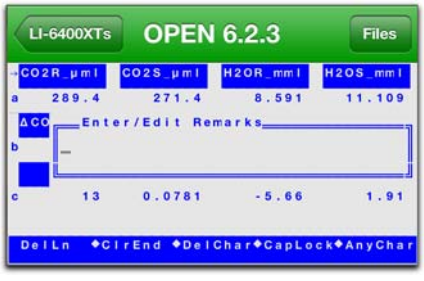


1. Starting at the Main Screen, touch F4 to go to New Measurements.

2. Touch F1 to open a log file.



3. Name the file. If you enter a name that exists, you will be asked if you want to overwrite it. It will be OK if you do, so you can touch **o** (for overwrite) if you get that message.

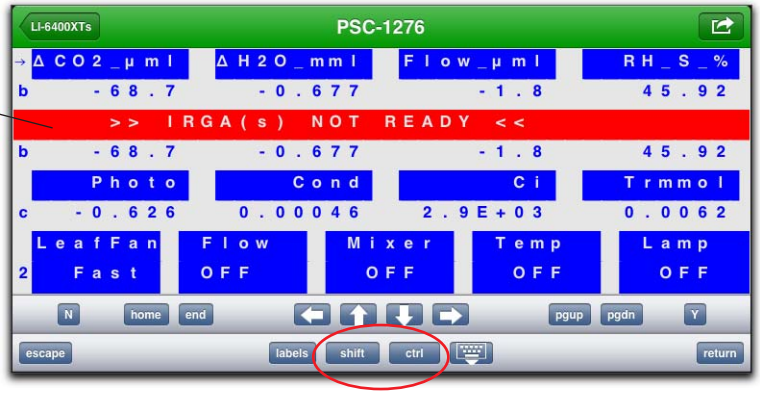


4. You will be prompted for a remark. You can leave it blank, or enter anything you wish. Touch **return** in the tool bar, or else **return** on the iOS keyboard.

5...10. Touch **F1** 5 or 6 times, with a few seconds in between each touch. This will log an observation to the file each time.

11. Touch **f3** to close the file.

By the way, if you get an annoying red message, you can ignore it, or clear it by sending a control z. That is, touch the **ctrl** key (its label will change to **CTRL+**), then touch the **z** key on the iOS keyboard.



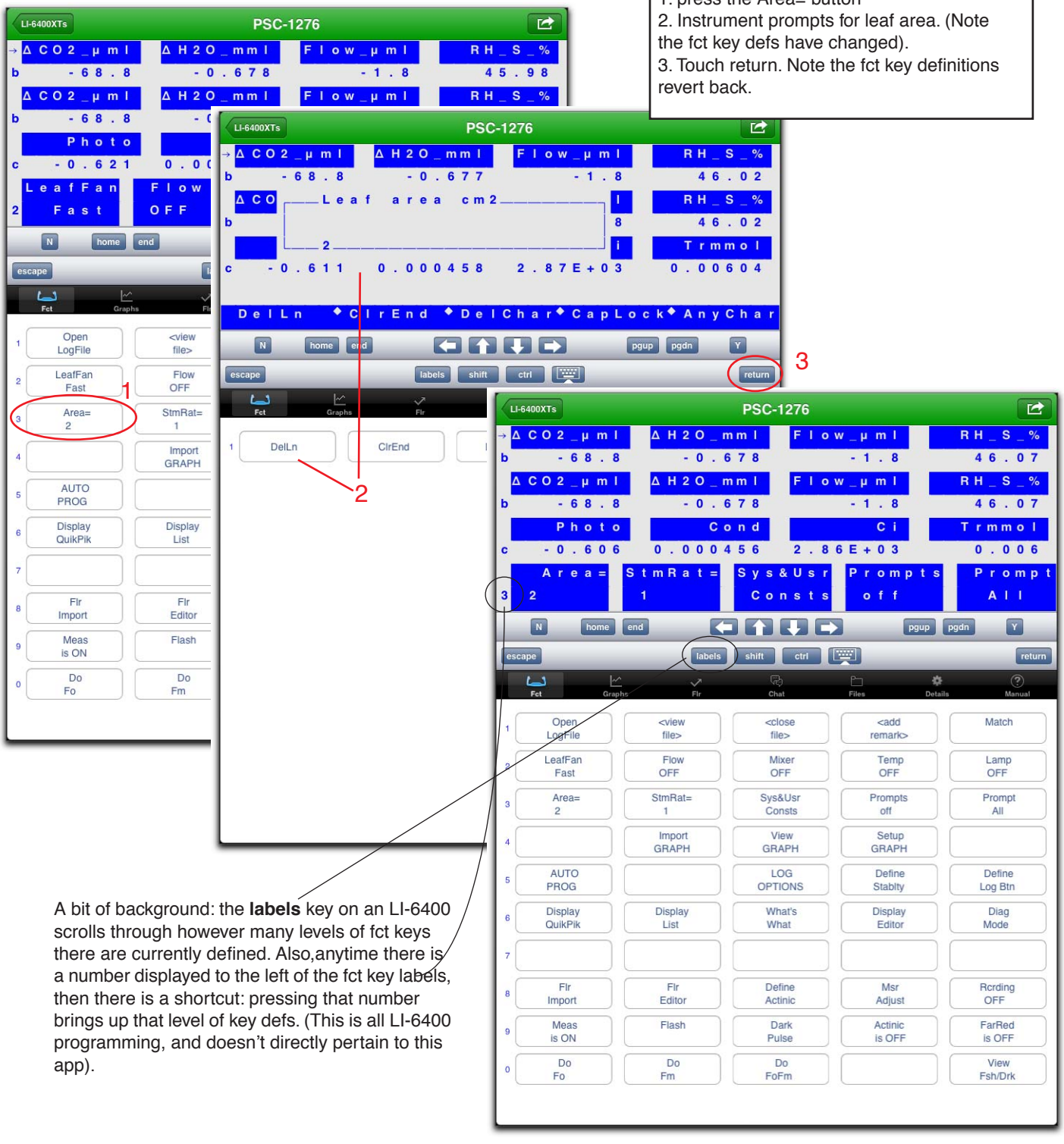
The **shift** and **ctrl** keys in the toolbar are “sticky” for one subsequent key press).

Comments on Testing the Tab Bar Views

Fct

This view shows all currently defined Fct keys in a convenient pallet. To test, simply navigate around and watch the definitions change. Touch some of the buttons and see that the instrument responds. An example is below.

1. press the Area= button
2. Instrument prompts for leaf area. (Note the fct key defs have changed).
3. Touch return. Note the fct key definitions revert back.

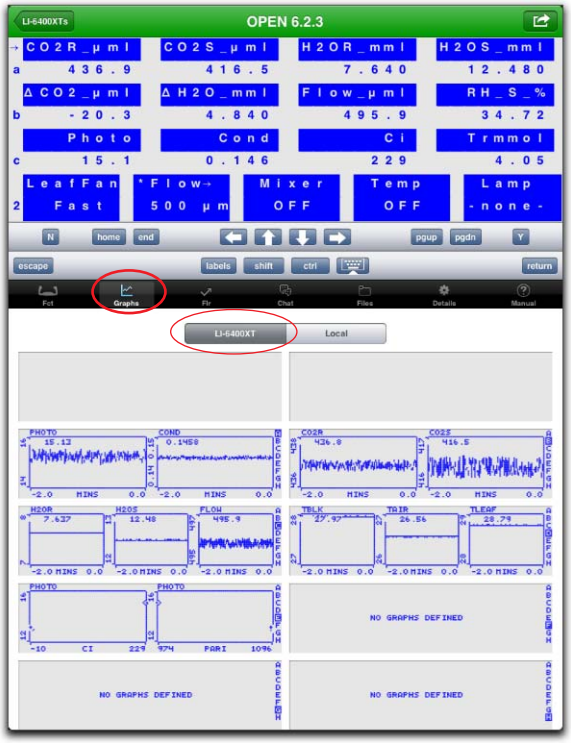


A bit of background: the **labels** key on an LI-6400 scrolls through however many levels of fct keys there are currently defined. Also,anytime there is a number displayed to the left of the fct key labels, then there is a shortcut: pressing that number brings up that level of key defs. (This is all LI-6400 programming, and doesn't directly pertain to this app).

Graphs

The graphics require that you have the instrument in New Measurements mode (see A Quick LI-6400 Navigation Lesson) and that the instrument be running version 6.2. This latter won't be an issue unless you try this with an earlier version simulator.

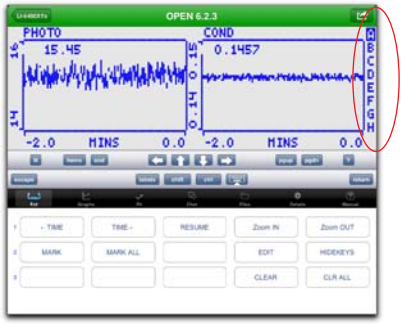
The are two parts here: the **LI-6400XT** segment shows the graphs that the LI-6400 creates and displays.



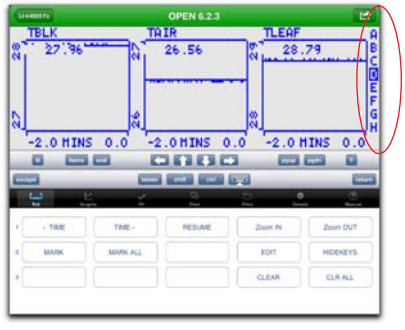
This view shows all 10 of the LI-6400's graphics planes at once. The top two blank ones are two graphics planes that the instrument uses for other purposes, and the bottom 8 are for real time graphs in New Measurements mode.

Some background: To view these graphs on an LI-6400, you can switch to the Fct view (1) and press the View Graph key (2). There are 8 graphics planes (denoted A through H) used for real time graphs, and you can switch between then by touching that letter on the iOS keyboard (**a**, **b**, etc.), or by using the up and down arrow keys. To get back to the normal text display, press **escape**.

Graph A

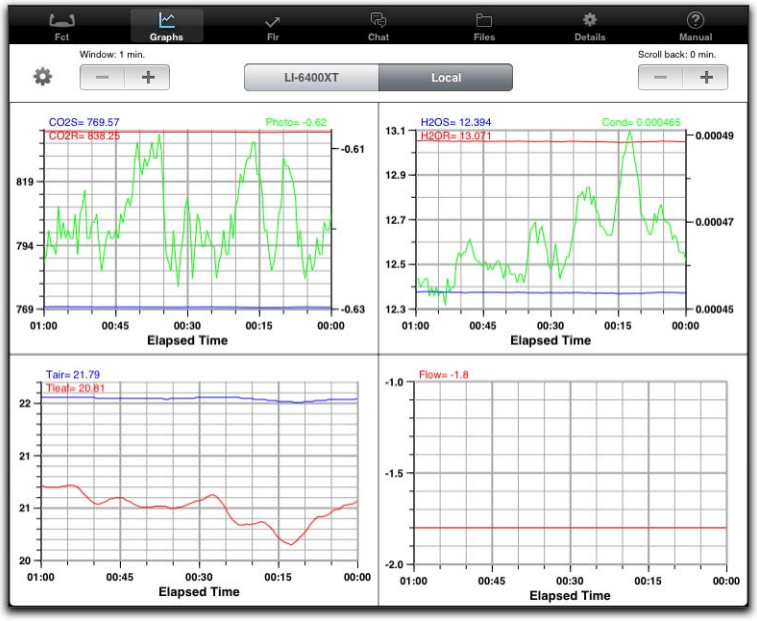


Graph D



Note there are three levels of fct keys defined for the graphs, but they don't appear on the LCD display. Pressing the **labels** button would make them appear.

The **Local** segment shows graphs generated on the iPad.



These graphs are generated by the iPad app, based on incoming data. There can be up to 8 graphs.

Gestures supported on these graphs:

- touch - brings up context menu (UIActionSheet) for...
...left or right axis - edit that axis
...legend item - edit that item
...on a graph - edit that graph
...empty space - add new graph
- horizontal pan - changes graph time offset (right value)
- horizontal pinch - changes graph's time window (left value)

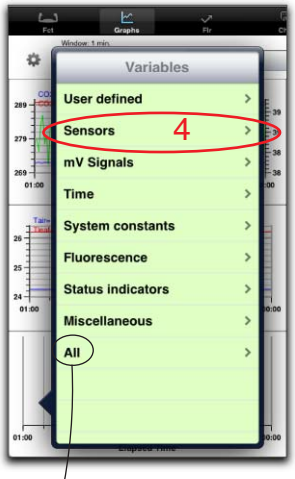
Resetting or saving the graph definitions:

Change time window for ALL graphs.
(Pinching changes only 1 graph)

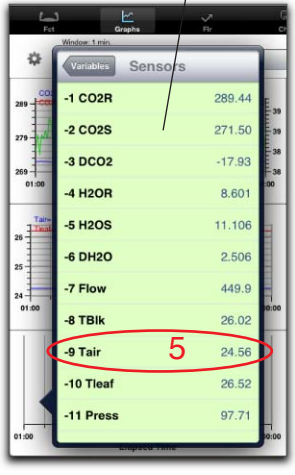
Change time offset for ALL graphs.
(Panning changes it for 1 graph)

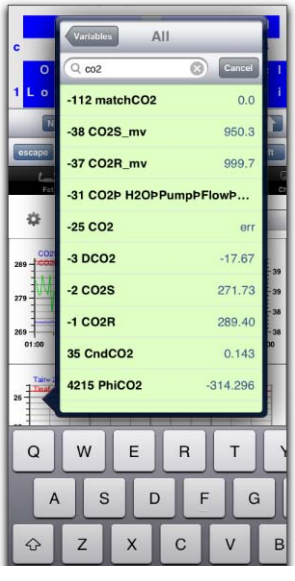
Some background: The LI-6400 has a long list of variables that users are used to picking from in various contexts. There are two types of variables, those that are defined by the system, and those that the user can define himself. Every variable has associated with it an integer ID number. System variables are <= 0, and user defined are > 0. It is from this list that these real time charts are drawn, and you encounter a form of this list when adding a chart or changing an axis, as shown below:

Adding a chart.
1. Touch anywhere
2. Select “Add New”. A new chart is made and added, and the option to add a variable appears.
3. Touch “Add variable”
4. The variables are broken into categories. Pick “Sensors”.
5. Select a variable.
6. The new chart begins

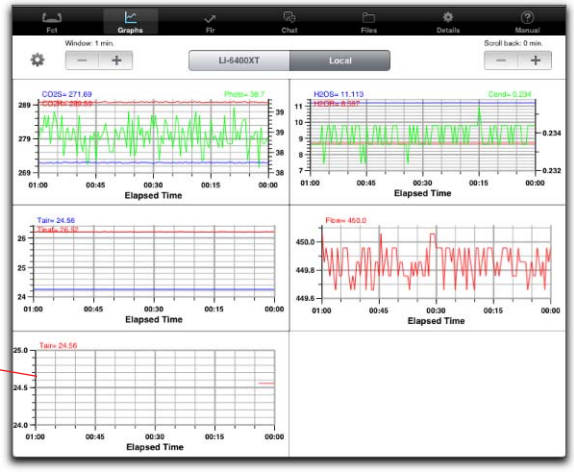


IDs, Names, and current values



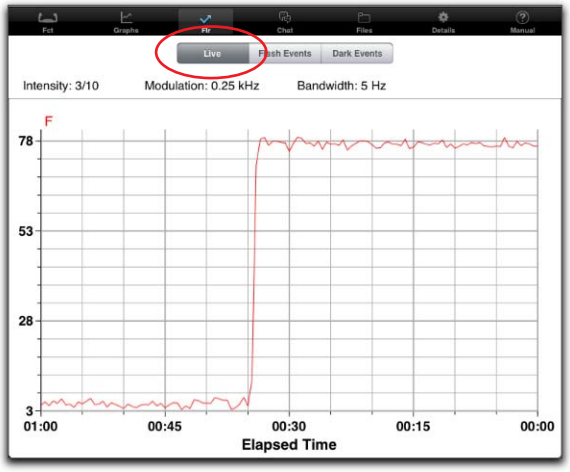


The “All” option lets you search the list by name



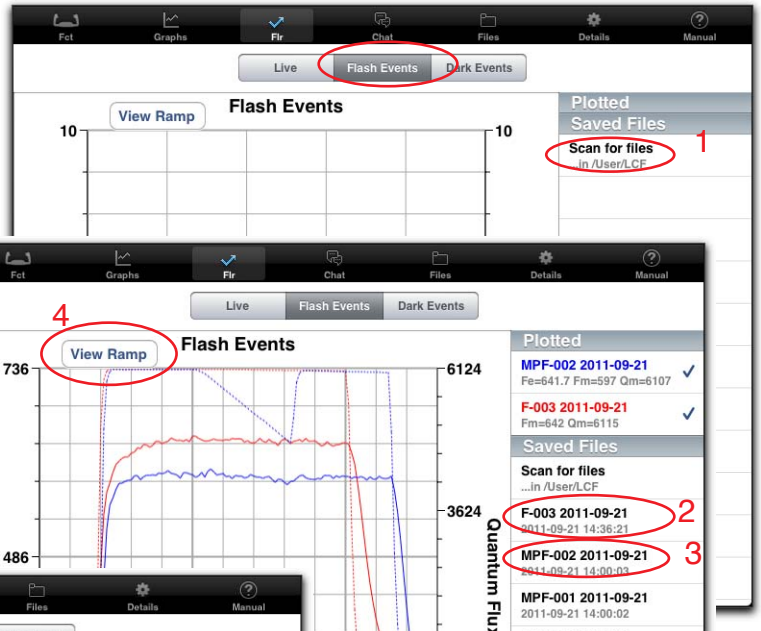
Flr

There is an optional attachment for LI-6400s that is known as a fluorometer, and this tab is all about that. There are three sub-parts: one monitors live output from the fluorometer, so naturally requires one to be in use. The other two parts plot data files that have been previously generated by the fluorometer.



Live Trace: There will only be a live trace on this chart if the connected LI-6400 is configured for a fluorometer. (I will try and have psc1276 so configured). Also, the instrument must be in either the Main Menu, or New Measurements mode.

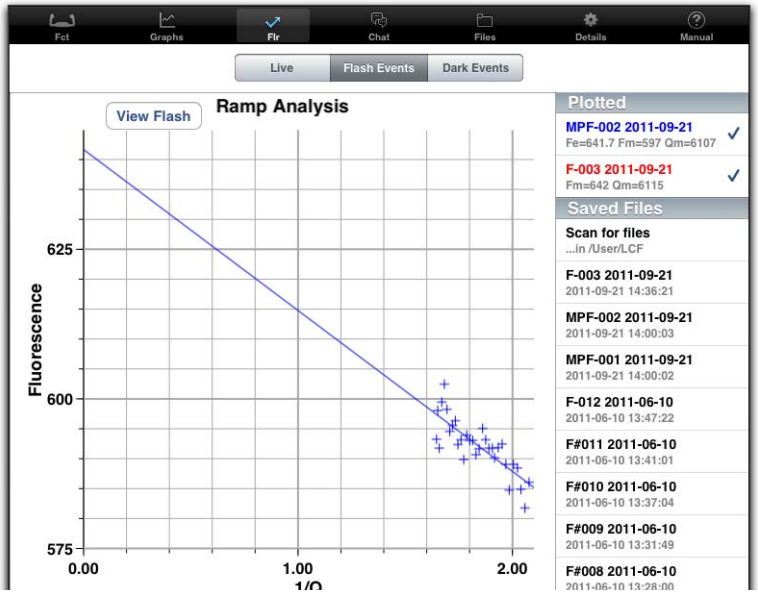
The Flash Events view allows you to plot flourescence data that has been stored in files on the instrument. (psc1276 will have some files like this, but a simulator would not). It does not matter what the instrument is doing for this to work.



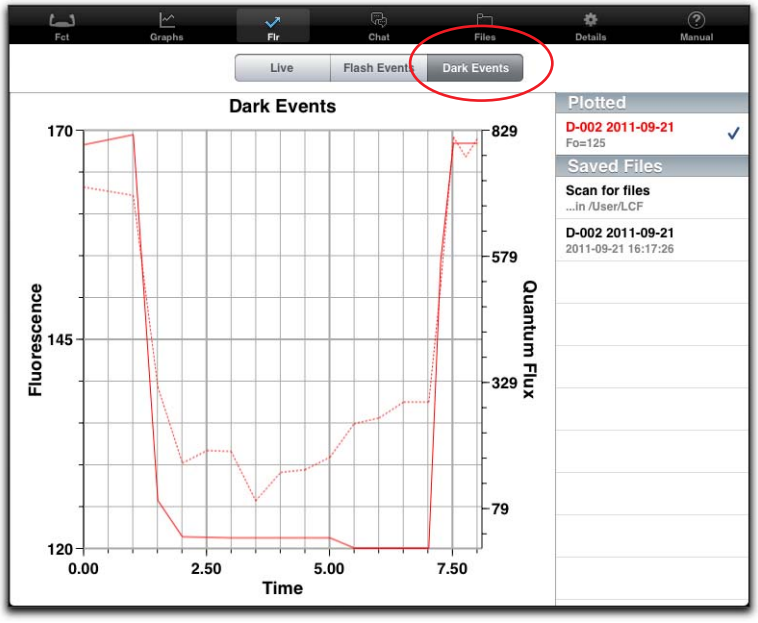
1. Scan for the file list
2. Select a file to plot
3. Select a second file
4. Touch the **View Ramp** button. (This does an anbalysis only on plotted files whose name starts with MPF...)

Flash plot gestures: vertical pinch, to zoom in on upper portion of graph)

Plotted list: Touch - select or de-select. (Selected files are plotted.) Left swipe to remove.

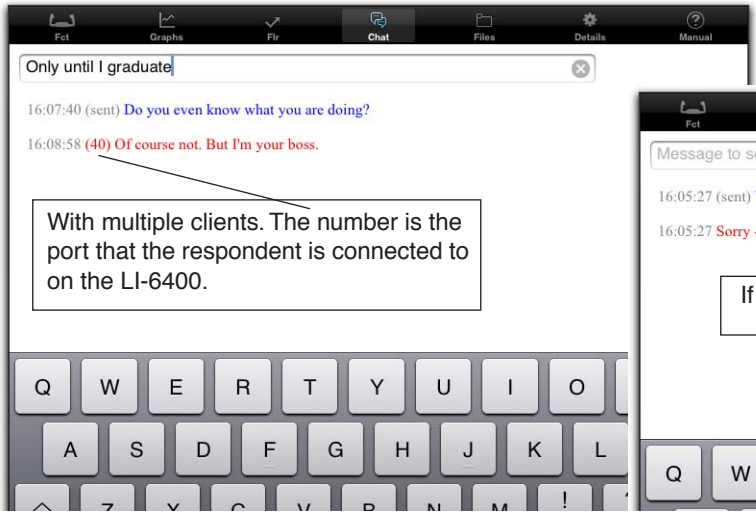


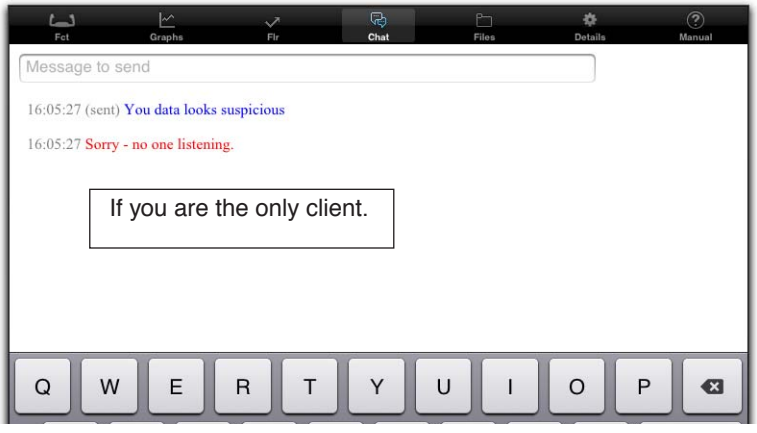
The Dark Events tab is similar to the Flash Events.



Chat

The Chat view allows messages back and forth between all clients attached to the same LI-6400. If you connect to psc1276 via the remote server (Option 1 - Use li6400.licor.com), and there is someone connected to it locally, then you can send messages back and forth with Chat. If the LI-6400 (or simulator) only has one client, it will respond to any chat message you send it with a “no one is listening” response.



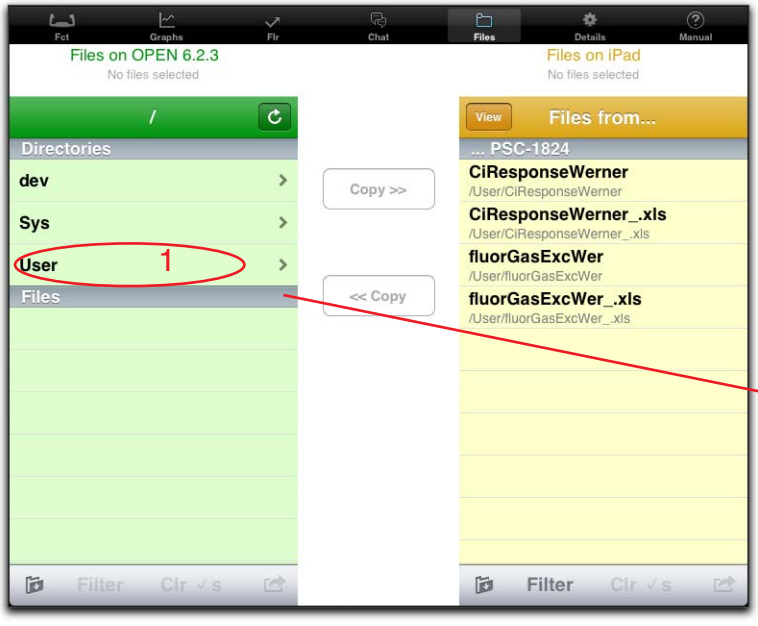


Files

Some background - the “Files” tab sheet provides a way for the user to view and access files on the LI-6400s file system. The file system (or at least the portion of it that users access) on an LI-6400 (or a simulator) has three directories in the “root”:

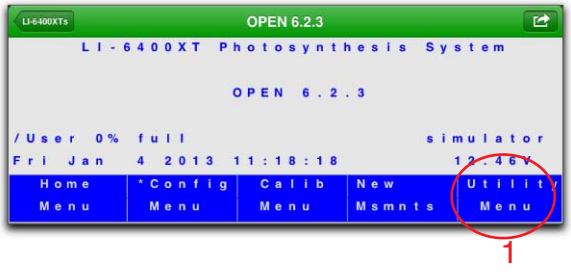
/dev	*contains a handful of calibration files*
/Sys	*a hierarchy of LPL (script) files and directories that constitute OPEN*
/User	*contains user data, and a directory named Configs, which holds configurations.*

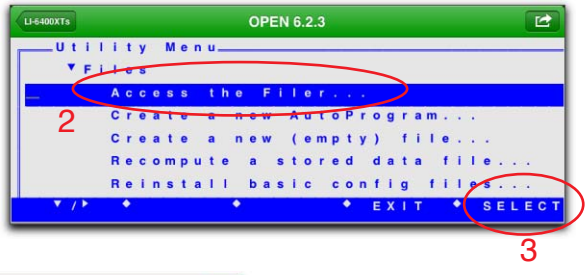
The left side shows the instrument (or simulator) file system. How to navigate to the data files is shown below:

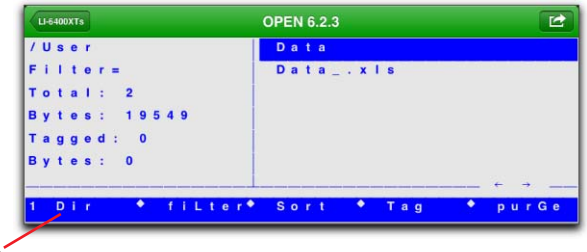


Note: We created two files when we logged a data file back in How to Create a Data File. Data is a text file, and Data_.xls is an Excel file (a very old version 2 format).

FYI, the way one explores the file system from an LI-6400 is to use the Filer, in the Utility Menu.

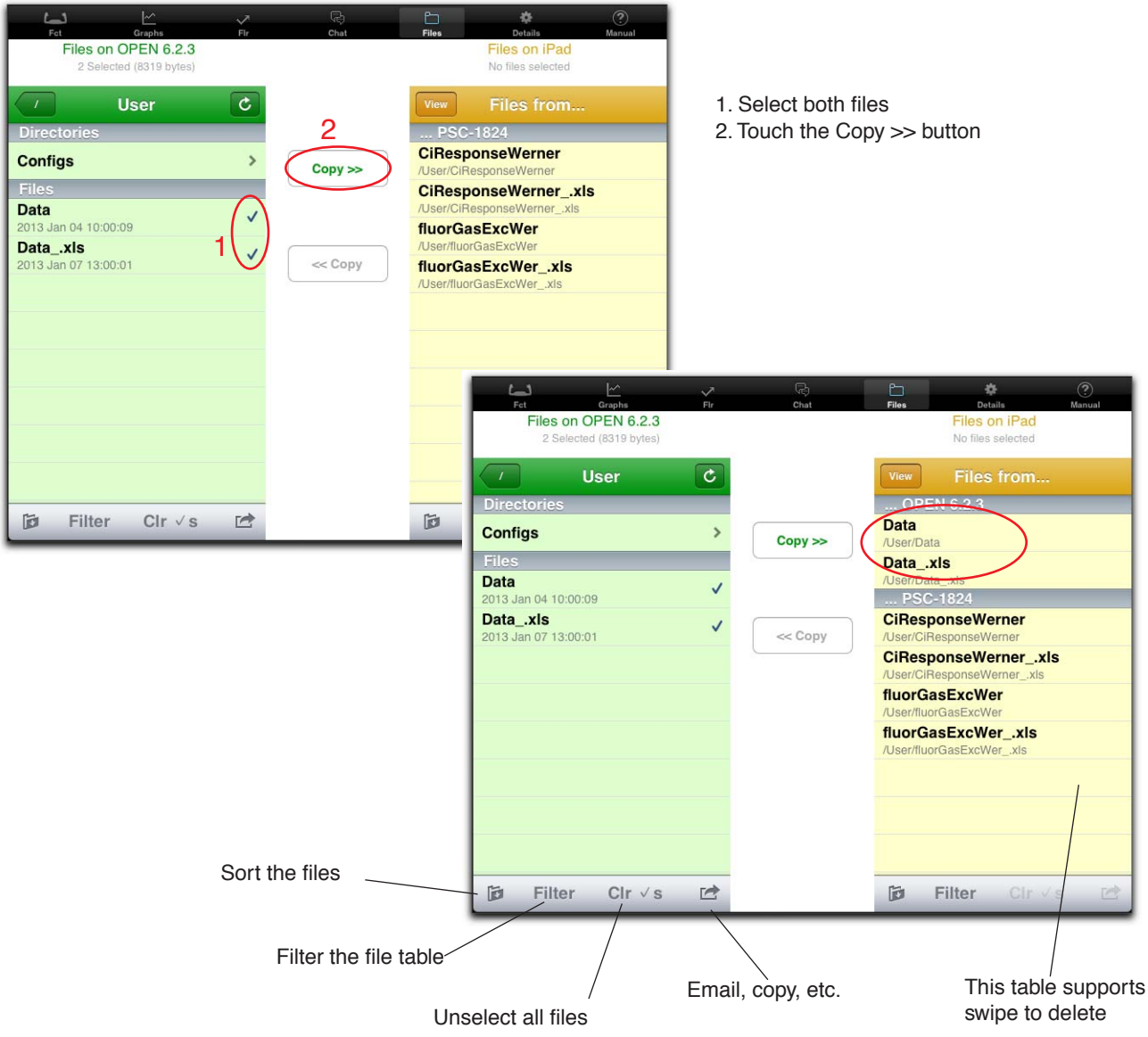






Change directory

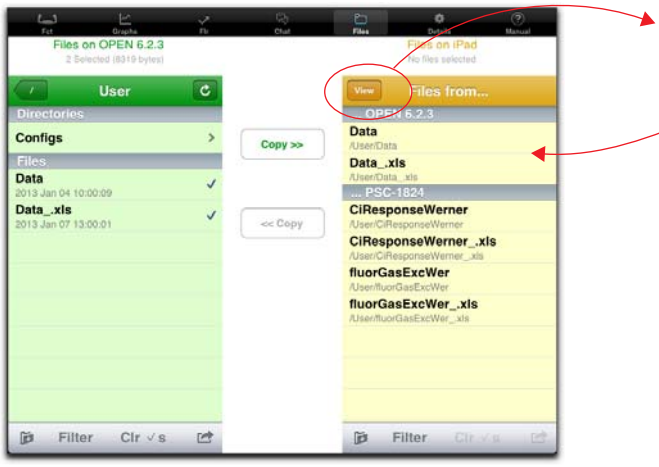
Download data files. We'll use the simulator, and the file (actually two files) we created above in How to Create a Data File. To copy the files to the iPad:

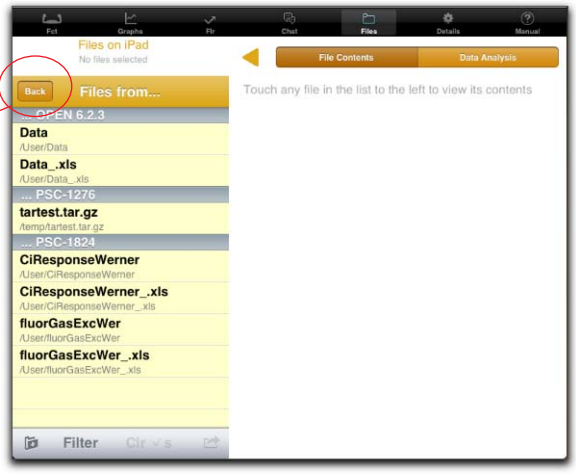


1. Select both files
2. Touch the Copy >> button

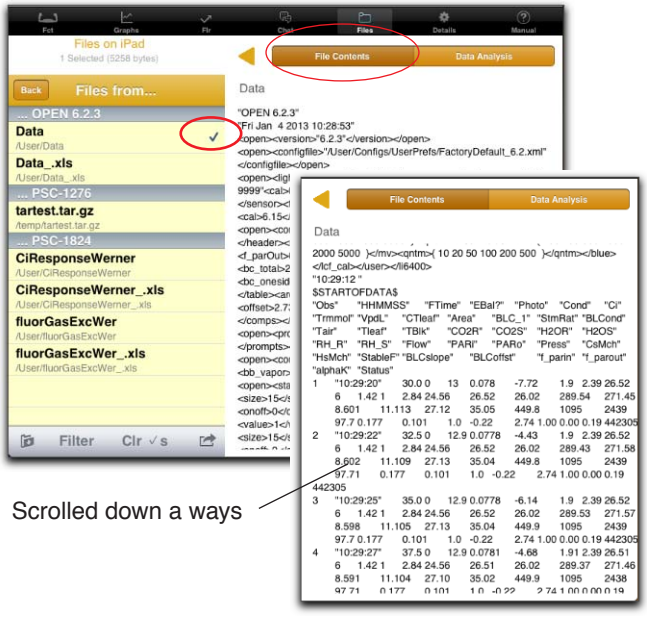
Note: you can transfer any sort of file back and forth - it does not have to be a data file. If you poke around in the /User/Configs/AutoProgs directory, or the /Sys/Lib or /Sys/Open directories, for example, there will be lots of files to use for this. These files will be viewable as text, but will not have any data in them you can plot.

Touching the View button puts us in a mode where we can view the files.



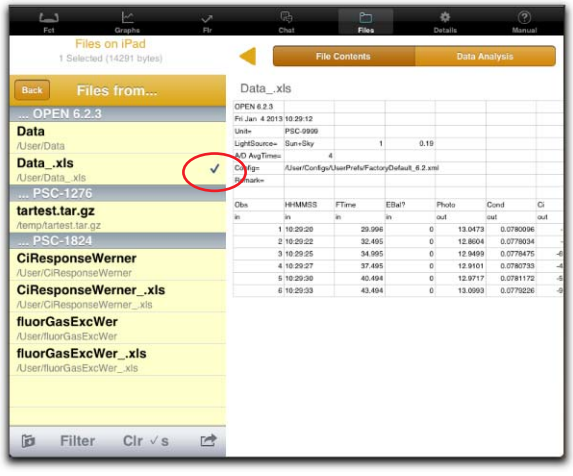


Viewing a text file:

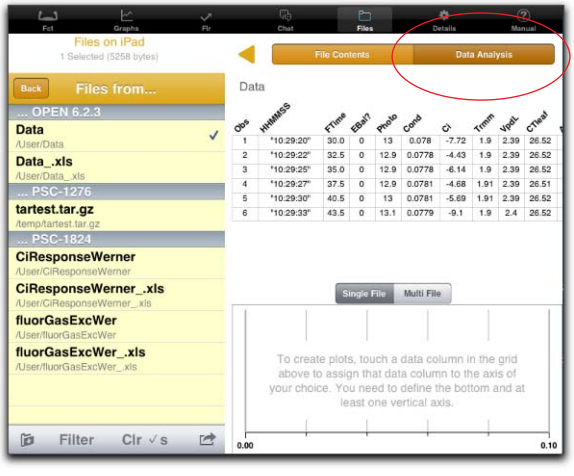


Scrolled down a ways

Viewing an Excel file:



These files contain different headers, but the data portions are the same (just stored differently). If data files have no data (just header), obviously they won't be plotable (next).



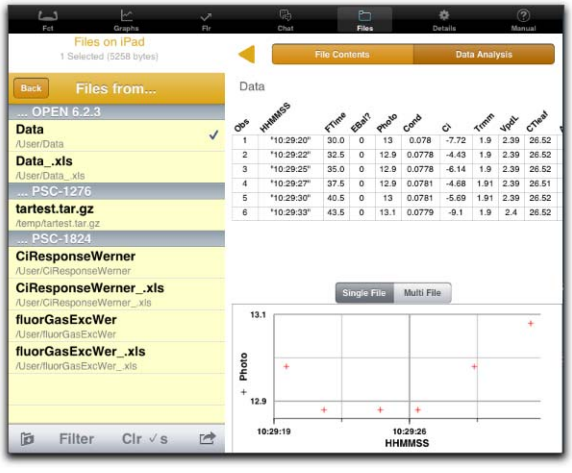
For either format data file, the Data Analysis segment will show just the plotable data in a scrollable grid. This data can be plotted in the graph at the bottom (next).

The sequence below illustrates how a plot is defined, how to plot a different file, how to plot multiple files.

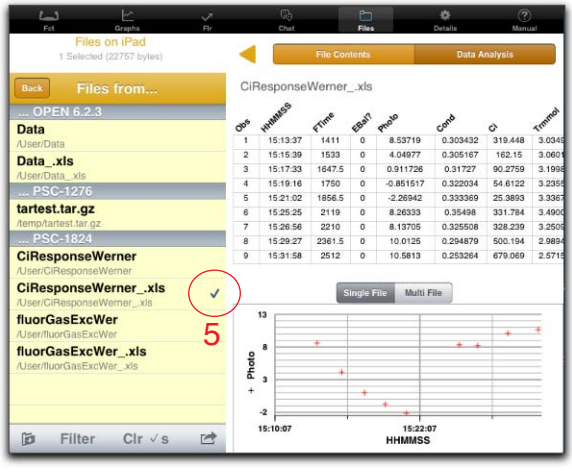
1. Touch a column and (2) make it the horizontal axis.

3. Touch another, and (4) make it a vertical axis.

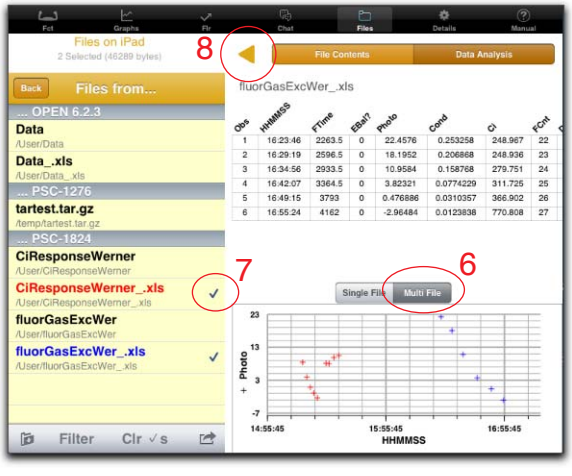
A chart is now defined.



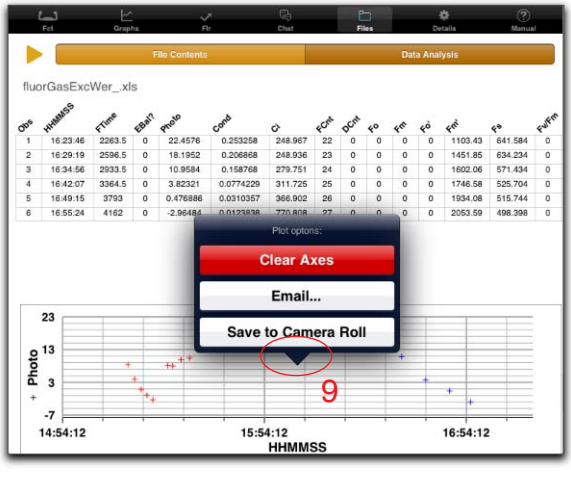
5. Plot a different file by selecting it from the list.



6. Select Multi-File, and 7. select another file, and see both plotted on the graph. 8. Expand the plot space.



9. At any time, you can touch a chart and get some options.

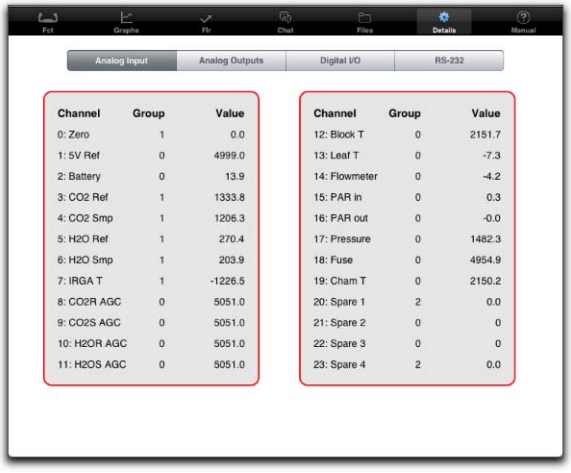


Details

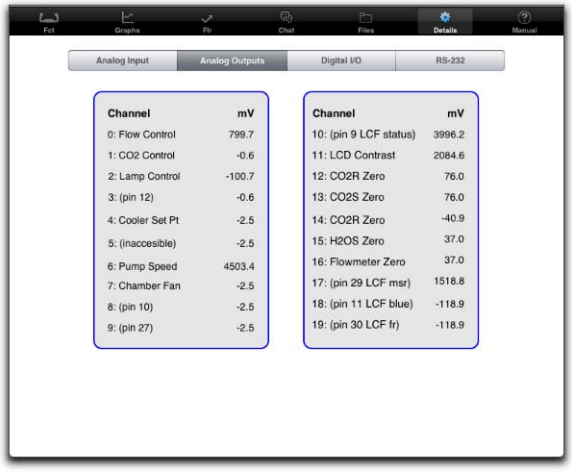
The Details view shows the current values of an LI-6400's 20 analog outputs, 24 analog inputs, the 5 digital i/o ports, and also what goes out the RS-232 port.

When connected to an actual instrument, none of these (except the RS-232 view) is interactive; they just display information from the instrument.

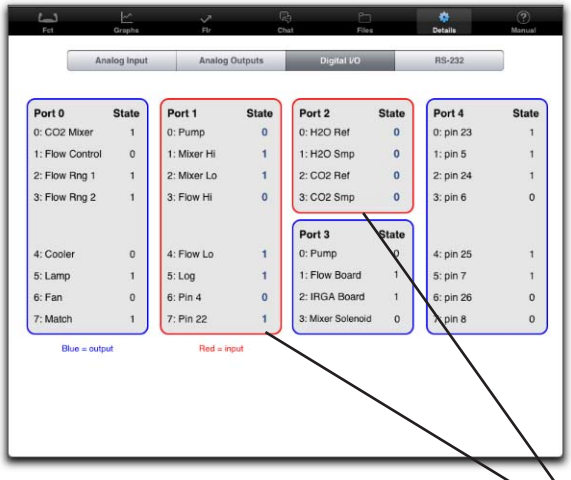
Analog Input channels



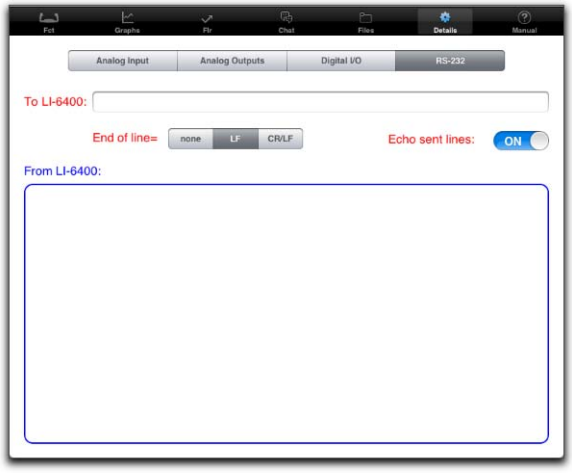
Analog Output channels



Digital channels

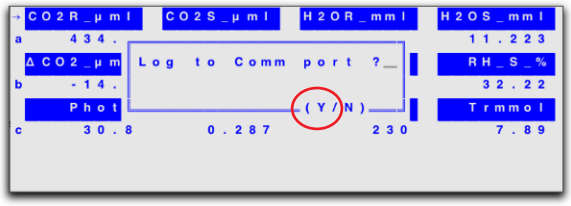


RS-232



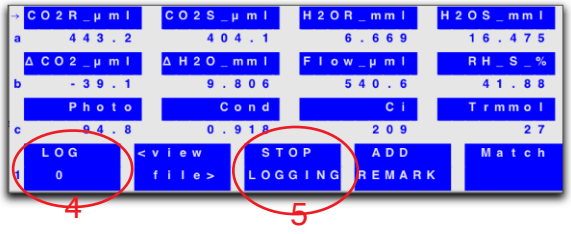
If connected to the simulator, the digital inputs (in the red boxes) can be toggled by touching the 1 or 0. The affect this has on a simulator is, depending on the input, to make warning messages come and go in New Measurements mode.

To make an LI-6400 (or simulator) spew something to its RS-232 port, you can do the procedure below:

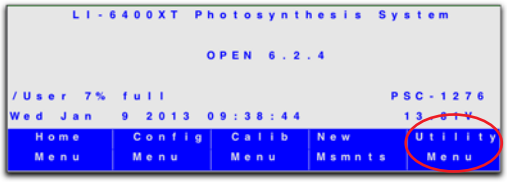


3 - press **Y** on iOS KBD or toolbar

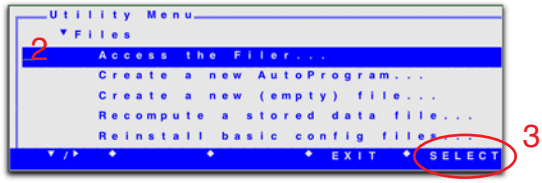
1. Open a log file, but ...
2. ...press **escape** or **cancel**, and you'll be prompted about the Comm port.
3. Press **Y** (on the iOS KBD or else on the toolbar). This header information will at that point be written to the comm port, so will show up here.
4. If you wish, log some data points by pressing **f1** for each.
5. When bored with it all, press **f5** (Stop Logging).



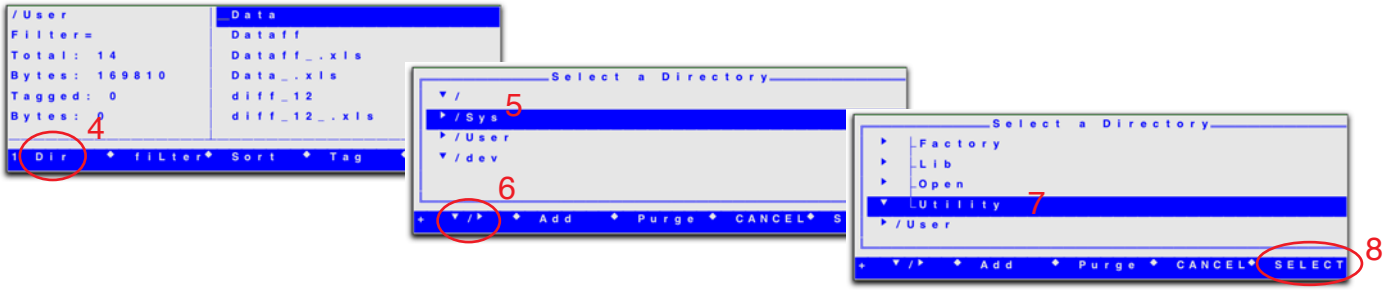
The most direct way to test the part of the RS-232 view that sends data to the LI-6400 to treat as incoming RS-232 data is to run a terminal emulator program on the LI-6400 (or simulator), as shown below.



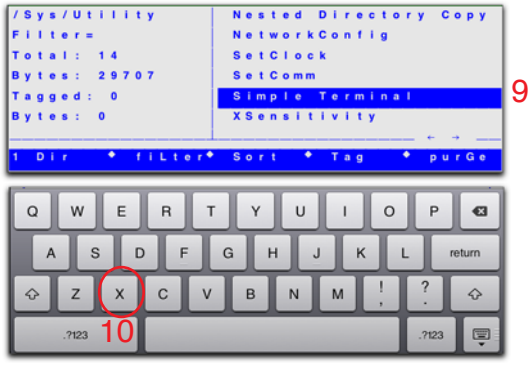
Start at the Main Screen, and touch **Utility Menu** (1) .



Open the **Files** node and highlight **Access the Filer** (2), and touch **Select** (3).

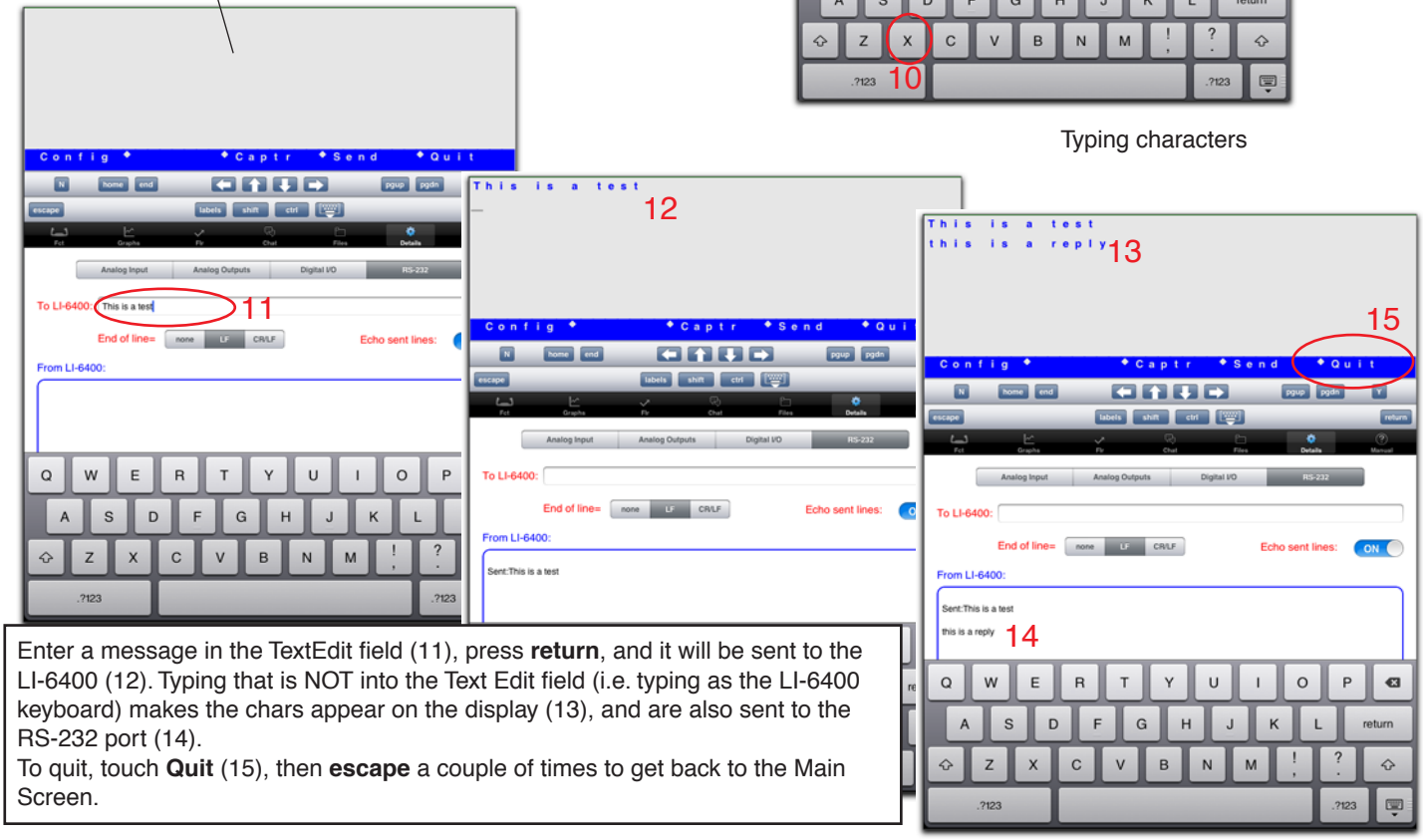


Touch **Dir** (4) , highlight **Sys** (5), and open (6) it, scroll down to the **Utility** directory (7), and touch **Select** (8). Then highlight **Simple Terminal** (9), and touch **x** (10) on the iOS keyboard.



Typing characters

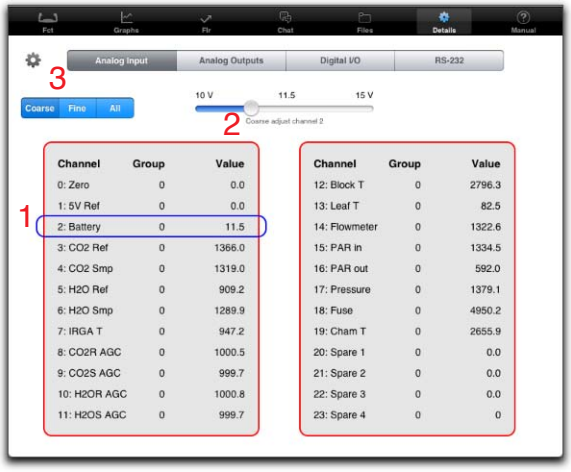
You are now running a terminal emulator on the LI-6400. Typing chars sends them out the RS-232 port, incoming chars are displayed.



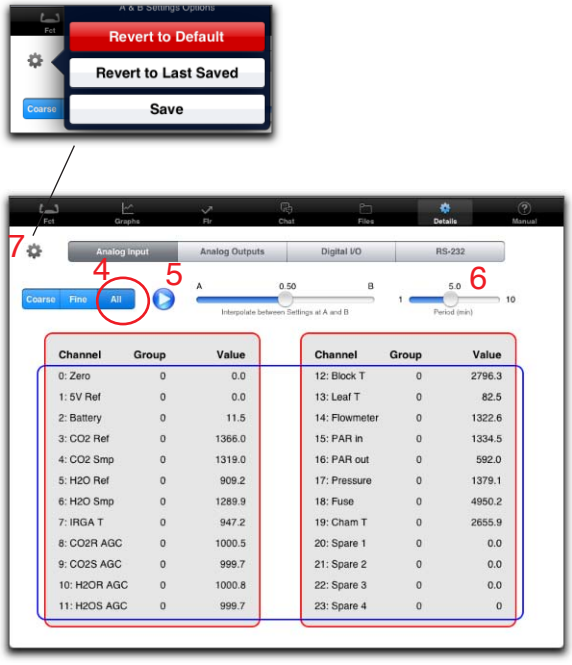
Enter a message in the TextEdit field (11), press **return**, and it will be sent to the LI-6400 (12). Typing that is NOT into the Text Edit field (i.e. typing as the LI-6400 keyboard) makes the chars appear on the display (13), and are also sent to the RS-232 port (14).
To quit, touch **Quit** (15), then **escape** a couple of times to get back to the Main Screen.

When connected to the simulator, the user can set the state of any digital input by touching it, and they can set the value of any analog input as shown below:

Analog Input channels (with Simulator)



To change any value,
1. touch the row
2. move the slider
3. **coarse** or **fine** sets the sensitivity of the slider.



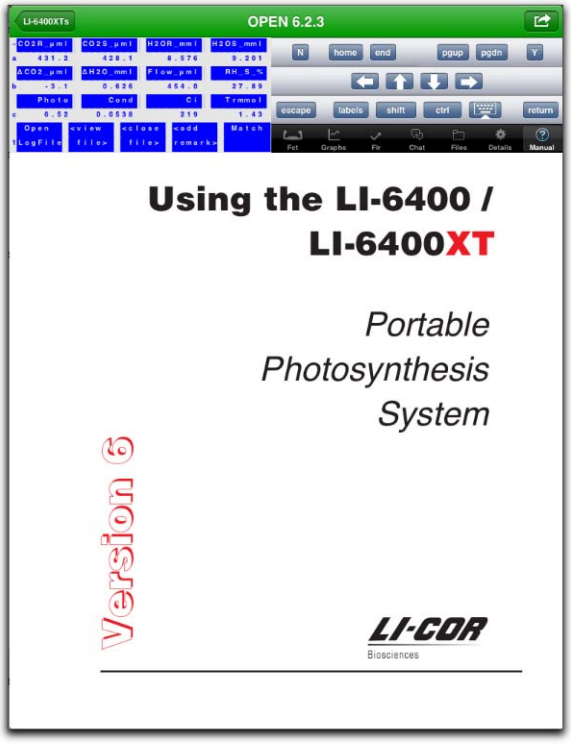
To change all values simultaneously in a sinusoidal fashion, touch the All segment (4). The slider (2) will then adjust all values between their predefined end-point settings.

The run button (5) will cycle between the endpoints automatically, using the specified period (6). Endpoint settings can be saved (7)

When analog inputs change, you can view the results on the real time graphs, among other places.

Manual

The operating manual for the LI-6400 is available from two places in the app.
While connected to an instrument or simulator, the manual can be viewed in the Manual tab. It is also available from the main screen of the app. The difference between the two is the latter does not show an instrument LCD, or context help suggestions.

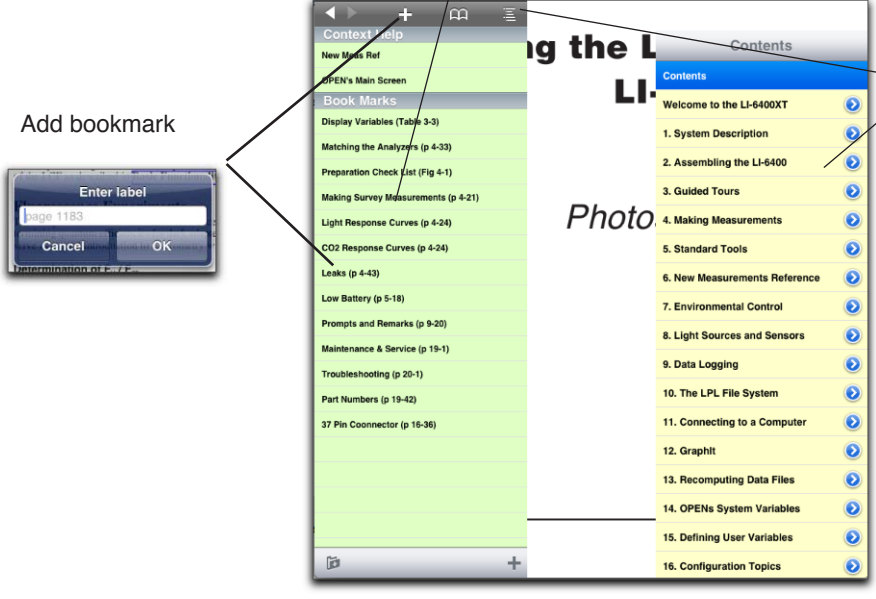


Gestures supported:
1. touch - toggles tool bar in upper left
2. swipe left and right - turn pages (if not zoomed)
3. tap right or left side - turn pages
4. pinch - zoom
5. double tap - center page, undo zoom

Context and Bookmarks slide in from left

Add bookmark

Content (outline) slides in from right.



The context sensitive help is illustrated below (in landscape mode so it is always visible):

Starting from the Main Screen (1), there is one entry under Context Help. Touch it (2), and the manual jumps to that page (3).

Next, touch Utility Menu (4).The context list adds an item (5). Touch it, and the manual goes to that page (6).

Navigate down to “Network Status” (7), and touch Select (8)...

...the Context list adds an entry (9). Touch it, and the manual jumps to that page (10).