



CO₂ Flux User Manual

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Version 1

Sponsor

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Introduction

CO2 Flux is a mobile Android application for use with the LI-840A gas analyzer. The application can be used to observe, collect, and organize data streamed from the analyzer into user specified data sets. It is designed to replace the data collection system implemented by LI-COR, by providing many features not present in their system such as advanced organization, live data readout, and included metadata.

Installation

Requirements

In order to successfully use the application, the user will need an Android tablet device running Android 7.0 or higher, as well as an LI-840A gas analyzer and all the cables that come included with it. Depending on the model of tablet, it may also need an adapter to convert the gas analyzer's USB output to the port type present on the device.

NOTE: The software may also work on mobile phone devices running Android 7.0 or higher, but the software was designed for tablet sized screens, and UI elements may appear differently than they do in the manual.

How To Install CO2 Flux:

1. The installation requires downloading the APK titled "CO2Flux.apk" from Github. The APK can be found here:

<https://github.com/CO2Software/LI840AInterface/blob/master/CO2Flux.apk>

2. Download the APK onto the mobile device. If the download is not available on a mobile device, download the APK on a computer. Then, email the APK to the mobile device, where it can then be downloaded.

3. Android may give warnings about the installation. Make sure that the permissions are allowed. It will ask if you would like to Install CO2Flux, press “Install”. Then press “Done”. Navigate to “All Apps”, this is where CO2 Flux will be found.
4. After Installation is successful on the device, open the application. You will be prompted to allow for permissions. The required permissions are Camera, Location, and Storage. The app will not allow you to proceed without these permissions. Once the permissions are set, installation is complete.

Configuration and Daily Operation

Navigation

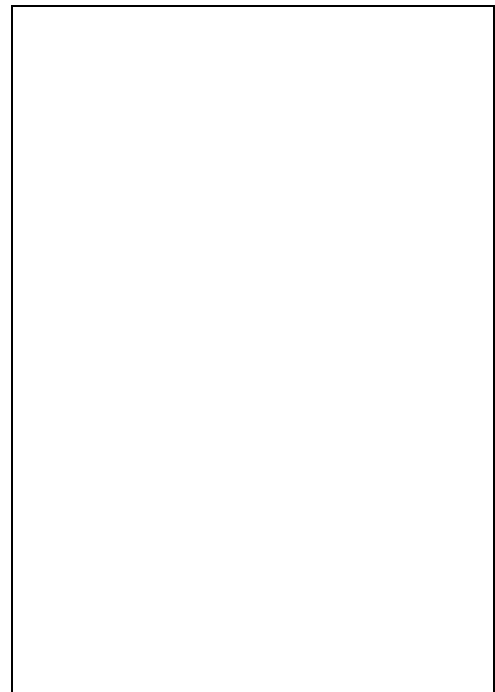
This application requires no further configuration if all of the steps were followed in the Installation Process. CO2 Flux contains 5 screens for application navigation. The flow diagram shows the mapping of the screens and their relation to each other. Every time the Application is opened, they will be taken to the Home Screen. The Home Screen acts as a point of navigation towards either the MetaData Screen or the File Directory. For Collecting New Data Readings, the user will press the “Start New Data Set” Button. For reviewing old datasets, the user will press the “File Directory” Button.

Collecting Data Readings

Entering Metadata

Upon pressing the “Start New Data Set” Button on the home screen, the user will be directed to the MetaData Screen. Here, the user can enter in all information pertaining to the New Data Set they are about to collect. This screen has eight Text Fields, three of which are required. All of the other fields are optional fields. All fields have character restrictions and a character limit on the length.

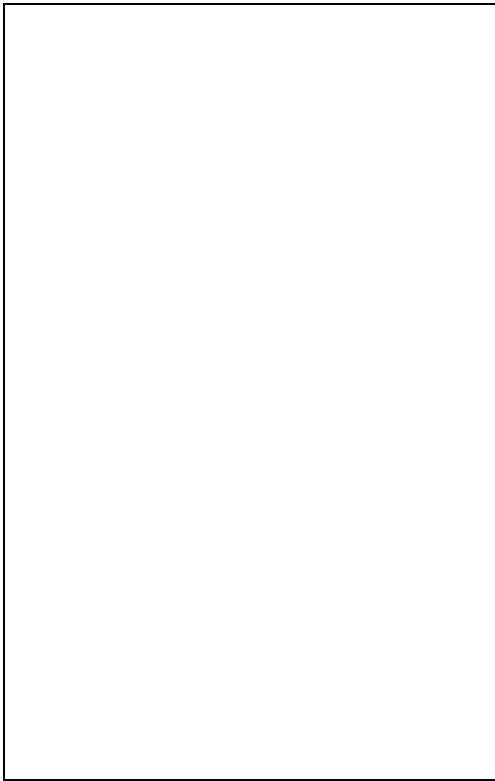
1. **Required Fields:** The required fields are Operator Name, Site Name, and Sample ID. Each field has restrictions on characters and length.
2. **Optional Fields:** The optional Text Fields are, Temperature, Comments, Longitude, Latitude, and Elevation. If they are left empty, they will be listed as “NA” when saved.
3. **AutoFill:** Operator Name and Site Name will both be filled in with the values of the last data set. Time and Date are always filled in automatically.
4. **GPS:** If there is a GPS signal, Longitude, Latitude, and Elevation will be filled in automatically for the user. This process that takes about 5-10 seconds. If no signal is found, the user can manually fill in the fields.
5. **Image:** Lastly, the user has the option to take a picture. In addition, all images taken by the camera are also saved in the device’s gallery. The dataset itself will only save the most recent image taken, which can be seen in the image preview.
6. **Finish Button:** Once the user has entered in the required fields, the Finish button is activated. Pressing finish will save the metadata, and take the user to the Graph Screen.



7. **Cancel Button:** The cancel button will take the user back to the Home Screen. All metadata that has been entered on the Metadata Screen will not be saved.

Reading and Recording Data

Once the Finish button is pressed, you will be taken to the Graph Screen. This screen acts as a point where the user can observe incoming data from the gas analyzer and specify their data set. Upon plugging in the gas analyzer, the user will be prompted to allow the software to access the device's USB port. This prompt must be accepted in order to successfully use the software.

1. **Live Graph Readout:** In this area, data streamed in from the gas analyzer will be graphed in real time.
 2. **CO₂ Button:** Changes the live graph readout to display the CO₂ values being collected.
 3. **H₂O Button:** Changes the live graph readout to display the H₂O values being collected.
 4. **Temperature Button:** Changes the live graph readout to display the temperature values being collected.
 5. **Pressure Button:** Changes the live graph readout to display the pressure values being collected.
 6. **Back Button:** Takes the user back to the metadata screen.
 7. **Enable / Disable Zoom Button:** Enables and disables zooming on the live graph readout. When enabled, the user can use two fingers to manipulate the X axis and Y axis range by performing pinching gestures. When zooming is enabled, the live graph readout stops automatically updating the view window and automatic Y scaling.
 8. **Start / Stop Logging Button:** Begins and ends the collection of new data sets. Attempting to start a new data set after one has previously collected will result in the deletion of the previous set.
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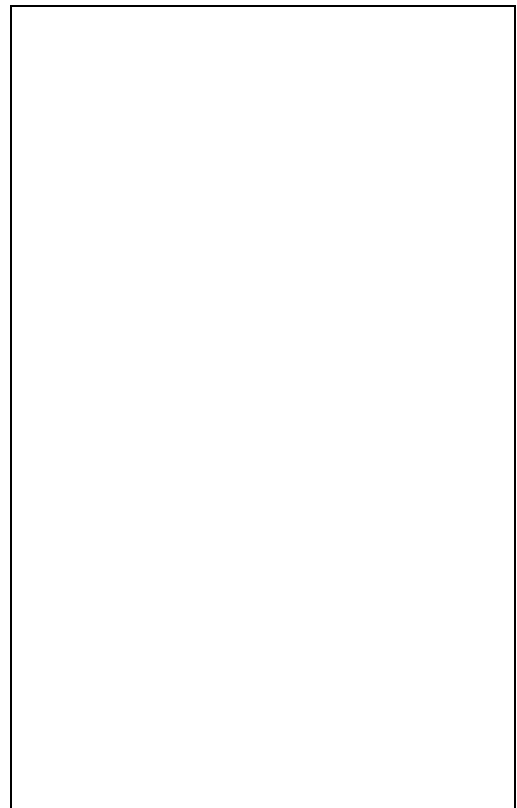
9. **Save Button:** Saves the last recorded data set to a file, along with its corresponding metadata file and image file before taking the user to the file directory.

Viewing Data Readings

Selecting and Viewing a Data Reading

When on the File Directory screen, simply tap on the file you want to view. It should be highlighted green, and the View button in the bottom of the screen should become solid and pressable. Press the View button after you have selected the file you want to view and that's it.

1. **Metadata and Comments:** Shows all pertaining metadata. Comments can be edited.
2. **CO2 Button:** Changes the live graph readout to display the CO2 values being collected.
3. **H2O Button:** Changes the live graph readout to display the H2O values being collected.
4. **Temperature Button:** Changes the live graph readout to display the temperature values being collected.
5. **Pressure Button:** Changes the live graph readout to display the pressure values being collected.
6. **Exit Button:** Takes the user to the file directory.
7. **Save Subgraph Button:** Saves the current subgraph to a new file, and return the user to the file directory.
8. **Apply Subgraph:** Applies the start and end points specified in the "Start,end" text field to the data set and recalculates the statistics.



Managing Data Readings

The file directory can be used to manage data sets which are saved on the device. This includes locating specific data sets, emailing them out of the application, deleting them off the device, and viewing them.

1. **Saved Data Sets:** All saved data sets on the device are listed here
2. **Data Set Filter:** Allows data sets to be filtered by a specific search parameter
3. **View Button:** Takes the user to the view screen with the data set they have selected
4. **Delete Button:** Deletes all currently selected data sets
5. **Email Button:** Prompts the user for the selection of an email client, where all currently selected selected data sets will be attached
6. **Home Button:** Takes the user to the home screen

Data Format Out of the Application

When the data is emailed out of the application there will be three files attached to each reading. These files are the graph reading file, the metadata file, and the image file. All have the exact name as the reading in the application but they all have a initial character to say which reading is which. The graph data file has a “G-” at the beginning, the metadata has an “M-” at the beginning, and the image file has an “I-” at the beginning. The graph reading and metadata are both Comma Separated Value files (extension .csv). The top row of both csv files say what each column of data represents. For the graph file is has Seconds, CO2, H2O, Temperature, and Pressure. Each column underneath each corresponding row has the data point for that variable. The metadata file has the column headers of Operator Name, Site Name, Sample ID, Temperature, Comments, Time and Date Longitude, Latitude, Elevation, R Squared, Regression Slope, Standard Error, X Start Range, and X End Range. The next row has all corresponding metadata in each column. The image file is a Portable Network Graphics file (extension .png).

Maintenance

Running out of Storage

Over time, the application will start to fill up with data. Most of the the log files barely even reach a kilobyte. Most devices have multiple gigabytes of extra storage, so it will take a while to fill up storage. The image file sizes have been taken into account. The image's have been reduced in file size to only be about 200 kilobytes. If the device ever runs out of storage, here are the steps you should take:

1. Check the storage of other apps on the device. The Android device may have apps that you do not want any more. Deleting these will free up storage. To do this, go to Settings > Storage. Here you can see what is taking up all of the storage on your device. From here, you can delete what you feel is not necessary. **Do not delete the CO2 Flux Application yet.** Steps 2 and 3 explore other options.

2. Delete images and videos from external storage. Images and Videos will take up a lot of space on the device. To delete these, simply go to the gallery and select images and videos for deletion. Please note that deleting external images taken by the CO2 Flux application will not delete them in the CO2 Flux storage. The Images in the gallery are simply duplicates, so it is safe to delete them!
3. Manually delete files inside the CO2 Flux Application. The application offers a delete functionality in app. See “Deleting Datasets” above.
4. If the device is still out of storage after the first 3 steps, you can delete the CO2 Flux Application Data. **This will delete all of the log files in your device.** This includes graph data, metadata, and image files. Before doing this, make sure that all files have been successfully exported out of the application via email functionality. See “Emailing the Selected Readings” above. To delete application data, go to Settings > Apps and Notifications, and find the CO2 Flux app on the list of apps. Select the app, and then select Storage. Then click both the Clear Data and Clear Cache Buttons.

Code Maintenance

Over time, changes will be made to this application. These changes could include UI updates, additional features, and bug fixes. In order to set up and edit the code, you must have Android Studio. Android Studio is a free development environment that this project was made in. Make sure that Android Studio is up to date. CO2 Flux is an open source project available on Github. There are 2 options for setting this up. Option 1: Manually Import the Project. CO2 Flux is an open source project available on Github. Download the project off the Github Repo: <https://github.com/CO2Software/LI840AInterface.git>. Next, import the project into Android Studio by finding the project in your Downloads Directory. You may want to then move it to a safer directory, such as AndroidStudioProjects. Now changes can be made. Option 2: Import The Github Repo using Android Studio. When Android Studio Opens, click “Check out project from Version Control”. A window will be opened, under Git Repository URL, copy and paste this line: <https://github.com/CO2Software/LI840AInterface.git>. This is a link to the current Github Repo. For the Parent Directory, it should be under AndroidStudioProjects, for example, mine is C:\Users\Admin\AndroidStudioProjects. For Directory name, LI840AInterface. Now changes can be made. Please note that this is just a Clone of the original code, which you may still upload to Github. To test the changes, under the “Run” tab, click “Run ‘app’”. To push the

changes to Github, To push just the APK, under the “Build” Tab. click “Build APK(s)”. Once it has finished building, a popup will appear. Click “locate” and this will show you the new APK in a directory. You can upload this APK, or any other changed files, to the Master Folder on Github, using the same link above. You may also create a new branch if desired.

Troubleshooting

There are a few known things that you might encounter that will not allow the application to work as intended. If something happens that is not listed here you can refer to the LI-840A user manual as it may be caused from the machine and not from the application.

Permissions

If you do not allow the correct permissions, the GPS, the camera and the graph screen may not have all of its functionality. The GPS will not produce coordinates on the metadata screen, the camera will not allow you to access it on the metadata screen, and the graph screen may not add points to the graph. The way to fix these problems is by navigating to the android home page and going to the settings. Then click applications and click on the CO2 Flux application. Finally go to permissions and enable all permissions. Once you are here you are able to allow all permissions for the application.

Connection

If you do not have a connection between the application and the LI-840A gas analyzer the graph screen will not add new points to the graph. If the RS232 to USB-C converter is not blinking with a light it is not pinging the device correctly and there is a misconnection either with the gas analyzers power or the cords connections. You would need to check to make sure all have a secure connection.

Signal

If you are not able to get GPS coordinates or not able to see a sent email on a different device, it means that you have to check to ensure the application has a signal and that you are not in a

building or completely covered by something above head. If the GPS coordinates do not automatically fill on the metadata screen the first problem is you could be covered from above. You are not able to get a GPS signal if there is complete coverage above head because the satellites cannot make a connection to the device. This being said GPS will not work inside any building. The next issue that could cause GPS and email not work correctly is you do not have a wifi signal. This would make emails not send. If the device does not have the three wifi bars saying here is an internet connection with the application you need to go into settings and make sure the application is setup to establish a connection meaning you need to have airplane mode off and wifi on.

Graph Screen Crash

Android Graph View was used for the application and they have some known issues. The most notable issue will be a graph screen crash because of zooming. This can be caused by zooming in too far. If you are zoomed in and a crash occurs you can just close the application (close from running by pulling up androids running applications and closing it) and when you reopen it the graph will be back to normal with all data intact.

Conclusion

This concludes the manual on how to download and operate CO2 Flux, a mobile application for the Android Platform. We hope that our product serves as a useful tool for many years to come for your organization. This app was developed by CO2 Software, a group consisting of Sam Beals, Jimmy Beasley, Andrew Greene, and Joey Kelroy. Although each member will be moving onto individual careers in the industry, we are happy to answer any brief emails in order to help you get your application up and running. Thank you for choosing to use CO2 Flux.