



# Operation Manual



**F-950**  
Handheld Ethylene Analyzer

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# DECLARATION OF CONFORMITY

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**Manufacturer:**

CID Bio Science, Inc.  
Felix Instruments – Applied Food Science  
1554 NE 3<sup>rd</sup> Ave  
Camas, WA 98607

**Declares that the CE-marked Product:**

**Product Models (s):**

Model F-950

**Complies With:**

89/336/EEC Electromagnetic Compatibility Directive  
73/23/EEC Low Voltage Directive

**Compliance Standards:**

|            |   |
|------------|---|
| EN 55027   | RF Emissions Information<br>Technology Equipment  |
| EN 50082-1 | EMC Immunity Standard   |
| EN 60950   | Safety of Information<br>Technology Equipment<br>Including Electrical<br>Business Equipment |



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October 23, 2014

Leonard Felix  
President

# Table of Contents

|                              |    |
|------------------------------|----|
| Introduction .....           | 1  |
| Features.....                | 3  |
| Specifications .....         | 4  |
| Unpacking the F-950 .....    | 5  |
| Operating Instructions ..... | 6  |
| Loading the Battery.....     | 6  |
| Basic Operation .....        | 8  |
| Measurement Modes.....       | 9  |
| Interfering Gases .....      | 11 |
| PolarCept.....               | 12 |
| Measure .....                | 16 |
| Continuous Mode.....         | 16 |
| Controls .....               | 17 |
| Trigger Mode.....            | 18 |
| Fixed Volume Mode .....      | 20 |
| Auto-Escape Feature .....    | 24 |
| Setup .....                  | 25 |
| Setup Mode.....              | 25 |
| Setup Calibration.....       | 26 |
| Setup Set Zero .....         | 27 |
| Setup Date and Time.....     | 29 |
| Setup RH Conversion.....     | 30 |
| Setup GPS .....              | 31 |
| File .....                   | 32 |
| File Select .....            | 33 |

File New ..... 33  
File Delete ..... 34  
File Review ..... 35  
Data Files on the Computer ..... 36  
Firmware Update ..... 38  
    Installing the F-950 Driver ..... 38  
    Updating the Firmware ..... 40  
F-950 Menu System Diagram ..... 45  
Appendix I: F-950 Controller Software ..... 46  
F-950 Production Test Check Sheet ..... 48  
Warranty Registration Card ..... 50



## Introduction

Congratulations on the purchase of your new F-950 Handheld Ethylene Gas Analyzer.

The new F-950 Handheld Ethylene Analyzer measures 3 critical gases: ethylene (C<sub>2</sub>H<sub>4</sub>), carbon dioxide (CO<sub>2</sub>) and oxygen (O<sub>2</sub>), to maintain optimum produce quality at every phase.

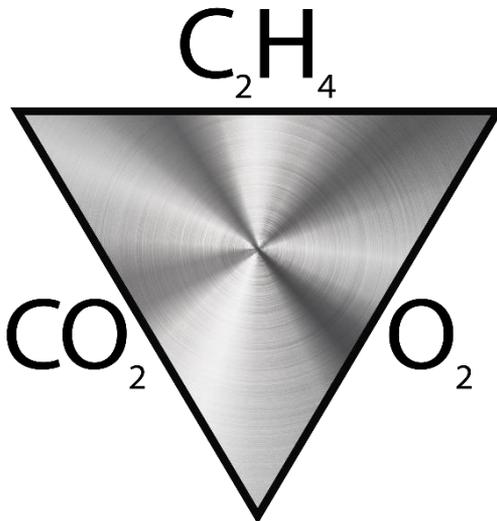
The F-950 is used to:

- ◆ Inspect storage and packing environments
- ◆ Verify ethylene mitigation efficacy
- ◆ Optimize ripening storage atmosphere conditions
- ◆ Quality assure MAP (Modified Atmosphere Packaging) for ethylene-sensitive products

Ethylene affects ripening, aging, and spoilage in produce. The F-950 measures levels of ethylene, CO<sub>2</sub> and O<sub>2</sub> in the atmosphere, and can be scaled to many environments, from cold storage to warehouse to transportation container. Simple to operate and weighing less than a kilogram, the F-950 uses an electrochemical cell to measure ethylene between 0-200 ppm in air. It records date, time, relative humidity, temperature, and coming soon GPS location. The F-950 is ideal for measuring ethylene production across a wide range of fruit or floral types and is especially suitable for managing ethylene emissions from perishable cut produce products.

The F-950 is ideal for Modified Atmosphere Packaging (MAP) applications. Most MAP gas analyzers are only equipped to measure CO<sub>2</sub> and/or O<sub>2</sub> concentrations. Quality assurance for perishable cut produce demands a more comprehensive analysis. The F-950 makes it possible to respond to the change in ripening gases to ensure longer shelf-life and higher quality commodities.

We hope you enjoy using your F-950 Handheld Ethylene Gas Analyzer.



## Features

- ◆ Portable, lightweight and easy to operate.  
*Rapid response time, with data points saved every second.*
- ◆ Repeatable, precise measurements.  
*Accuracy of C<sub>2</sub>H<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> at +/- 5%.*
- ◆ Three versatile modes of operation  
*Measure in Continuous, Fixed Volume, or Trigger mode depending on your application.*
- ◆ True sunlight readable transreflective display.  
*The contrast of the display increases under brighter sunlight.*
- ◆ Removable, re-chargeable standard sized batteries.  
*Included stand-alone battery charger enables charging one battery set while using another. Two sets of batteries are included with the device. Additional button-top 19670 (or protected 18650) batteries can be purchased from your preferred battery vendor.*

## Specifications

| <b>F-950 Specifications</b>  |   |
|------------------------------|---|
| Air Sampling Rate            | 60-500 mL/min                                 |
| Measuring Rate               | Open or closed loop, 1 sec intervals          |
| Data Storage                 | Removable 4 GB SD card                        |
| Display                      | Sunlight visible transfective LCD             |
| Operating environment        | 0°C - 45°C (0-90% humidity non-condensing)    |
| Battery Capacity             | 7 hours                                       |
| Dimensions                   | 7.1 x 4.75 x 1.75 in (18 x 12 x 4.5 cm)       |
| Weight                       | 0.95 Kg                                       |
| Enclosure                    | Powder coated aluminum                        |
| Warm-up time                 | < 3 minutes                                   |
| <b>Sensors</b>               |   |
| <b>Ethylene Sensor</b>       | Electrochemical                               |
| Nominal Range                | 0 – 200 ppm                                   |
| Lower Detection Limit        | 0.5 ppm                                       |
| Resolution                   | < 0.1 ppm                                     |
| Accuracy                     | ±5% Continuous mode<br>±10% Fixed Volume mode |
| <b>Carbon Dioxide Sensor</b> | Infrared Sensor, Pyroelectric detector        |
| Nominal Range                | 0 – 20% (200,000 ppm)                         |
| Full scale resolution        | 0.01% (100 ppm)                               |
| Accuracy                     | ±5% Continuous mode<br>±10% Fixed Volume mode |
| <b>Oxygen Sensor</b>         | Electrochemical                               |
| Nominal Range                | 0-100%  |
| Resolution                   | 0.1%  |
| Accuracy                     | ±5% Continuous mode<br>±10% Fixed Volume mode |

## Unpacking the F-950

The F-950 arrives with a hard-sided carrying case, two sets of batteries and a charger, a removable 4 GB SD card, and several accessory parts. The unit comes with an external conditioning chamber and potassium permanganate ( $\text{KMnO}_4$ ), used to scrub the air entering the system. A sampling port with needle is included for fixed volume samples from packaging and an external PolarCept filter for reducing interfering gases. The sampling port is pictured below, connected to the intake.



## Operating Instructions

**WARNING:** Do not store the F-950 without batteries! Charged batteries must be present in the instrument to maintain the accuracy of the sensors, even when the unit is powered off.

If the batteries of the F-950 discharge during storage, replace with charged batteries and allow the instrument to stabilize 48 hours before use. There is a small internal battery to maintain the bias voltage for the ethylene sensor. This small internal battery will last for 1 day without the main batteries before sensor sensitivity is affected by losing its bias voltage. The calibration parameter data is intact with or without batteries.

Fully charged main batteries allow for storage time of over 1 year. Aged batteries or batteries that started out with less charge will reduce the storage time available. The Li-ion batteries have little self-discharge and a life of about 3 years.

### Loading the Battery

The F-950 uses 18650 Li-ion 3.7V 3100mAh rechargeable batteries. For longer lifespan, charge the batteries at 0.25A. For a faster charge, charge at 1A. The batteries must be removed from the F-950 to be charged.

To remove the batteries, twist the battery compartment cap, located on the bottom of the case. The cap can be twisted with fingers or a screw-driver to tighten or loosen. Take care when removing batteries, as the cap is spring loaded. Both batteries should be inserted into the unit positive (+) side first (towards intake or top). The battery compartment and exhaust port are pictured below.



## Basic Operation

To turn the instrument on, press the green power button. The Felix Instruments logo will flash, followed by the main menu. The top of the display reads Felix Instruments, and the current version of firmware the unit is running is displayed in the lower left hand corner. The battery meter is listed on the lower right hand side of the display.

For information on the latest firmware version, please visit the F-950 support webpage ([www.felixinstruments.com/support/f-950-support](http://www.felixinstruments.com/support/f-950-support)).

The main menu displays the following options: Measure, Setup, and File.



To scroll between menu items in the list, use the Up and Down arrows. To select an option from the menu list, use the Right arrow. To exit, use the Left arrow.

## Measurement Modes

Three measurement modes are present on the F-950: continuous, trigger and fixed volume. To change measurement mode go to Setup > Mode from the main menu (page 25).

In fixed volume and trigger mode, the instrument reports values in terms of VOC (volatile organic compounds). VOC's are aromatic compounds like ethylene, esters and alcohols. Their production increase with produce aging and spoilage. The F-950 ethylene sensor cannot distinguish ethylene from many other VOC's. PolarCept was designed to optimize and improve the accuracy of ethylene measurements. PolarCept is an external water filter, which reduces the signal from interfering gases reaching the ethylene sensor. PolarCept is recommended in Fixed Volume and Trigger mode. PolarCept dramatically reduces the amount of interfering gases like alcohols and esters that are present in a sample, allowing ethylene to pass through to the sensors. For more information on PolarCept, see page 11.

**Continuous** measurement mode measures the air entering through the input of the instrument. The controls default to Loop "Open" and Pump "On". Continuous mode can be used **with or without the sample port** attached to the front of the instrument. The data is saved every one second in continuous mode.

**Trigger** measurement mode begins with the valve closed and the pump off. To start taking a measurement, press the square start button on the key-strip of the F-950 to initiate a new measurement. The pump will run and air will enter the F-950

until a stable reading has been reached for all sensors, or until the user stops the measurement by pressing the start button again. The final values will be displayed under the word “last” in the graph and saved to the SD card. The pump will then turn off until the user initiates a new measurement.

Trigger mode can be used **with or without the sample port** attached to the front of the instrument. The instrument will detect and report total VOC’s present in the sample.

**Fixed Volume** measurement mode draws in a sample of a small, set volume of gas (default 15 mL). **The sampling port with the needle attachment is required** for Fixed Volume mode and MAP applications. The instrument will detect and report total VOC’s present in the fixed volume sample.

## Interfering Gases

No analytical method is completely specific. Gases present in the environment, other than the “target” gas of a measurement, may affect instrument response. Interferences are not necessarily linear, and may also exhibit time dependent characteristics. The following table details the approximate cross-sensitivity of the ethylene sensor to several common interfering gases. A 20% cross sensitivity means that 100 ppm of the interfering gas would read the same as 20 ppm of the target gas (ethylene). Therefore, 20 ppm H<sub>2</sub>S should read <40 ppm on the F-950: 10 ppm NO<sub>2</sub> should read <5 ppm: 10 ppm Cl<sub>2</sub> should read -0.1 ppm.

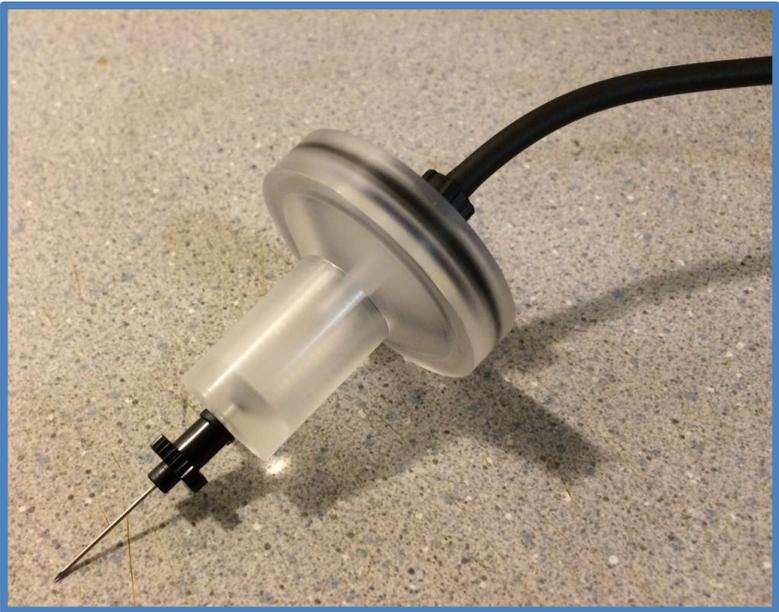
| Gas                           | Interfering gas (ppm) | Cross-Sensitivity (%) |
|-------------------------------|-----------------------|-----------------------|
| H <sub>2</sub> S              | 20 ppm                | < 200                 |
| NO <sub>2</sub>               | 10 ppm                | < 50                  |
| Cl <sub>2</sub>               | 10 ppm                | < -1                  |
| NO                            | 50 ppm                | < 80                  |
| SO <sub>2</sub>               | 20 ppm                | < 50                  |
| CO                            | 400 ppm               | < 30                  |
| H <sub>2</sub>                | 400 ppm               | < 0.5                 |
| C <sub>2</sub> H <sub>4</sub> | 80 ppm                | < 100                 |
| NH <sub>3</sub>               | 25 ppm                | < 0.1                 |
| HCHO                          | 4 ppm                 | 90                    |
| CO <sub>2</sub>               | 50000 ppm             | < 0.1                 |

Ripening fruit emit a complex mixture of hydrocarbons, including ethylene. Oxidation of these other gases in the electrochemical sensor cannot be readily distinguished from ethylene. This causes the ethylene value to be falsely high in the presence of interfering gas.

Felix Instruments has tested a method to absorb some of the competing gases and provide better ethylene measurements. This method, PolarCept, uses distilled water in an external chamber and has been shown to filter out some polar hydrocarbons and alcohols to produce less interference.

### PolarCept

It is recommended to use the external PolarCept filter when measuring a mixture of gas (such as when sampling fruit) or interfering gases may be reported by the instrument. The external filter can be used with any of the three measurement modes, and is recommended for Fixed Volume and Trigger Modes. PolarCept should only be used with **1.5 mL of distilled or deionized water**.

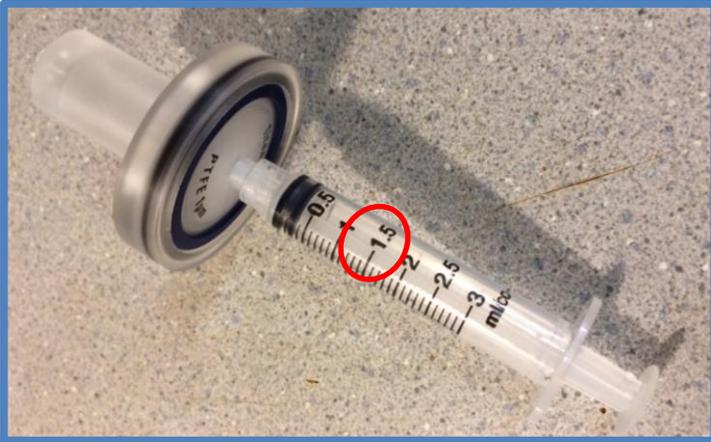


The PolarCept filter consists of a plastic molded part, hydrophobic filter and O-ring. It is also used with the “fixed volume tubing” and sample probe needle. A small plastic syringe is used to fill and empty PolarCept. Once the hydrophobic filter and O-ring are in place, it should be very difficult to remove it, creating a leak-proof seal. Additional hydrophobic filters are included as replacements, when the filter is soaked with water or damaged during removal.

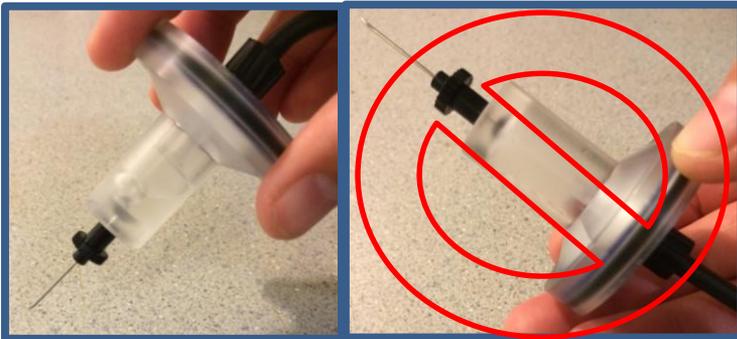
Eventually the water in the PolarCept filter will become saturated with trapped interfering gases and should be replaced with fresh distilled water. Saturation rates will depend on the measurement mode and amount of interfering gases present in the sample environment. The table below shows example saturation times when measuring headspace of bananas (with a maturity index of 5) in Continuous Mode. This sample contains various mixed hydrocarbons, ethylene and VOCs. The total VOC in ppm listed is the signal reported by the C2H4 sensor in ppm.

| VOC concentration | PolarCept saturation (min) |
|-------------------|----------------------------|
| 3 ppm             | 20                         |
| 100 ppm           | 1                          |

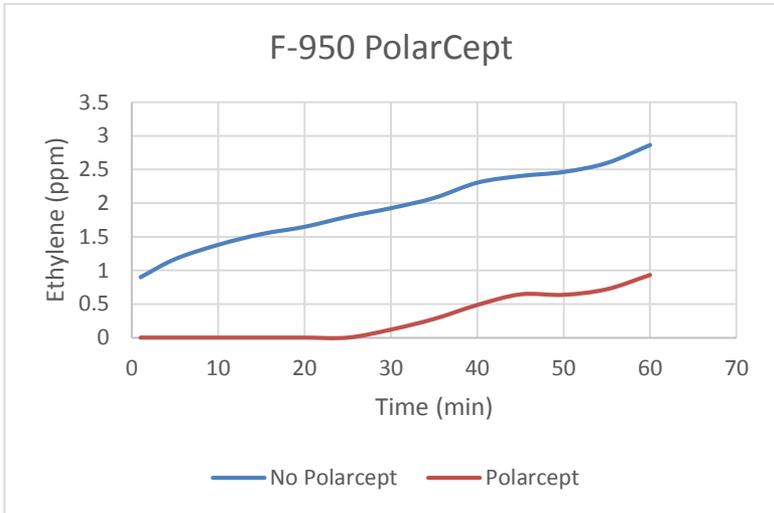
To fill the PolarCept filter, attach an empty syringe to the hydrophobic filter. The plunger of the syringe should be completely depressed. Lower PolarCept over a cup of distilled water and draw in **1.5 mL** with the syringe. Attach the sample needle and fixed volume tubing to stop leaks. To empty PolarCept, re-attach the syringe and push the water out the sample needle end.



To properly use PolarCept, keep the sample needle pointed downwards while measuring, as seen in the example below on the left. The water in the filter should “bubble” as the gas sample is pulled through it, causing some of the interfering gases to be trapped.



See the following graph of measured ethylene concentration by the F-950 with and without using PolarCept, measuring the same headspace of bananas. After about 20 minutes, the water becomes saturated, and the signal begins to rise with PolarCept.



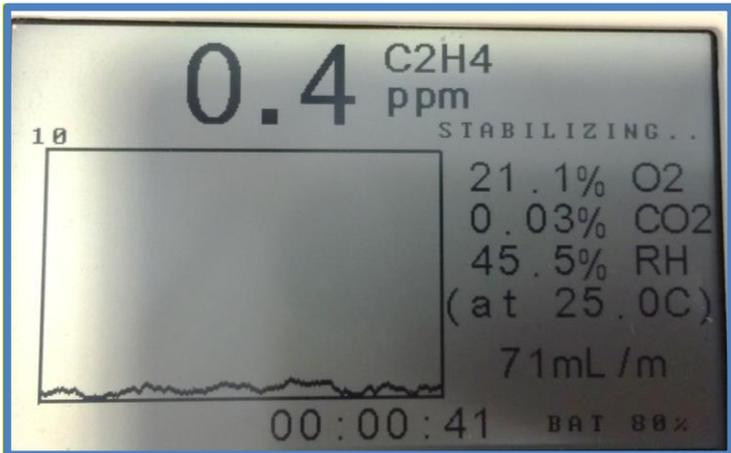
## Measure

From the main menu, press the right arrow when the word Measure is highlighted, to enter the measurement display screen. All measurement variables are saved to the SD card every 1 second in continuous mode. When the SD card is not present, the data will not be saved.

If sampling very high concentrations followed by very low concentrations, allow the instrument time to **purge** internal gas for the most accurate measurements.

## Continuous Mode

When in continuous mode, a graph of the concentration of each gas can be viewed over time. The default graph shown is the ethylene ( $C_2H_4$ ) concentration in ppm. To view the graph of the other gases, simply use the up and down arrows to scroll through them. The current gas being graphed is shown on the top of the screen with the concentration in large font as shown below.



The x-axis of the graph is time. The y-axis of the graph displays the range of the concentration (in ppm for ethylene and % for CO<sub>2</sub> and O<sub>2</sub>), and the dynamic range is labeled at the top. The y-axis scale is set by the highest value shown in the buffer. This range will scale vertically, dependent on the highest concentration of gas measured. If the concentration is small, the dynamic range will reflect this.

The graph begins on the left side and moves towards the right as more data points are added. Once the line reaches the right side of the display, the data will begin moving towards the far left, keeping the current time at the far right. The total measurement time is displayed below the graph.

Current Oxygen (% O<sub>2</sub>), Carbon Dioxide (% CO<sub>2</sub>) are listed on the right side of the graph when ethylene is being graphed. This data changes slightly when displaying the graph of other gas concentrations. The flowrate (mL/m) is displayed at the bottom. If Relative Humidity (% RH) and Temperature (degrees Celsius) are not seen on the display, go to Setup>RH Conversion and enter the actual temperature of the measurement gas (see page 30).

### Controls

From the measurement display screen, press the right arrow to view and change the controls. Access to the controls is only available in **Continuous** and **Trigger** measurement modes.

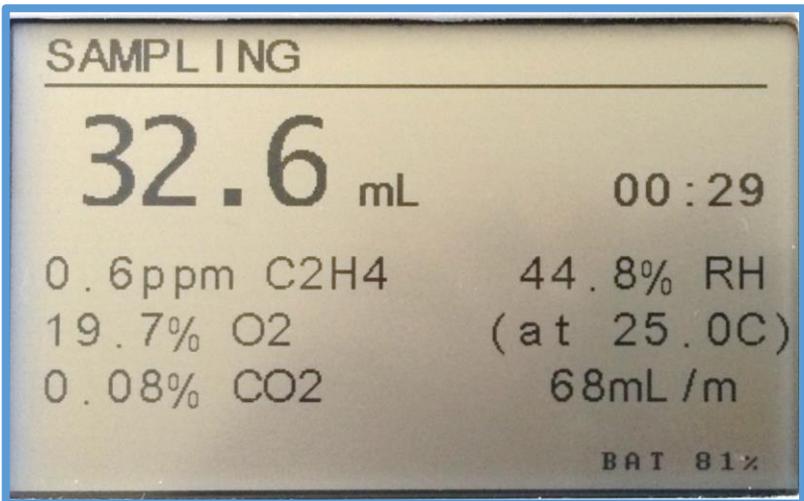
The internal volume inside of the instrument, or “Loop” can be Open or Closed. When the loop is open, the instrument is sampling air from the input at the top of the instrument and exhausting air through the output at the bottom of the instrument. When the loop is closed, air is circulated internally

through the tubes and valves to the input and output are closed.

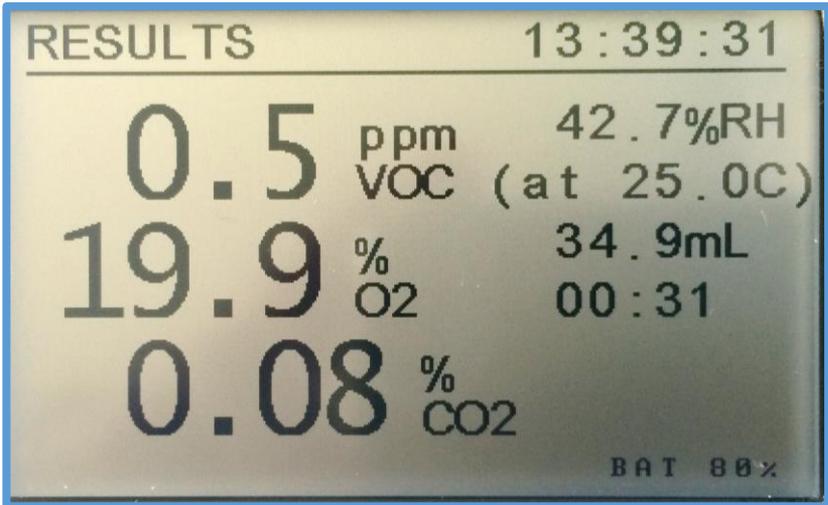
From the control screen, the Pump can be turned On or Off. When the pump is on, the unit will flow at 67 mL per minute, which is the default flow rate. When the pump is off the flow will drop to 0 mL per minute.

### Trigger Mode

A measurement in trigger mode begins with the valves closed and the pump off. To begin, press the square start button as prompted, to measure. This will turn on the pump and the ethylene sensor will stabilize before drawing in sample gas. Trigger mode will take longer to stabilize if the concentration is in a different range from the last sample (30 sec-1.5 min).



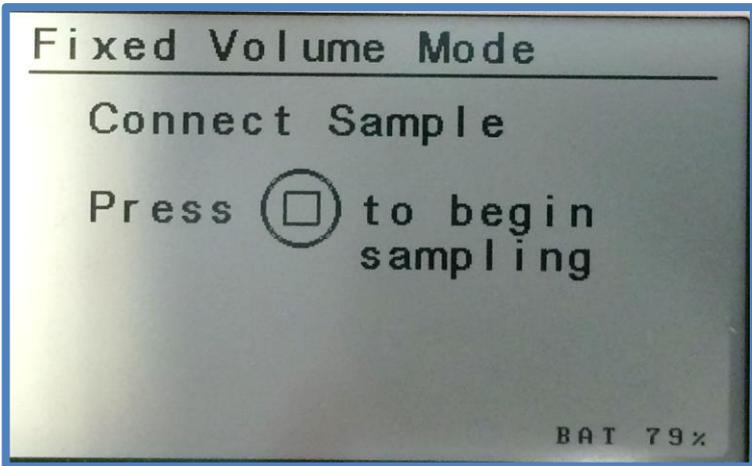
Once adequate sample has been collected, press the square button to stop the measurement and view the results. The maximum sample volume in this mode is 41 mL. The results will be saved to the SDcard.



Press the square start button to begin another measurement.  
Press the Left arrow to exit to the main menu.

## Fixed Volume Mode

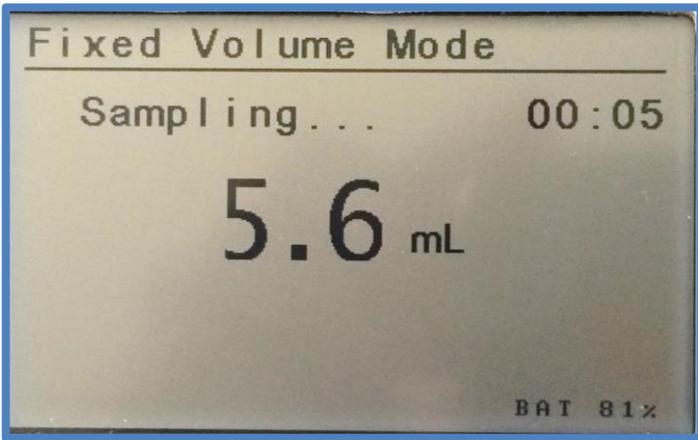
To begin, the unit should be disconnected from the sample of interest while the sensors purge, stabilize and equilibrate to the ambient environment. The instrument will purge for 5 seconds to remove the previous sample from the internal tubing of the instrument. If additional time is required, press the Right arrow to start the purge cycle again. Once stable, the instrument will prompt the user to connect the sample and press start to begin measuring.



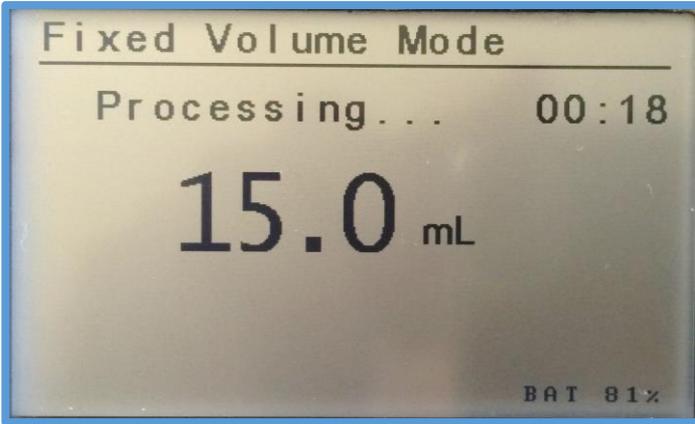
Assemble the probe by connecting the “Fixed Volume Needle Probe” black tubing to the intake of the F-950. Next, twist on a hydrophobic filter to the end of the tubing. The filter will prevent any moisture or debris from being sucked into the instrument. Finally, attach a sterile needle to the filter. Depending on the application, needles can be re-used.



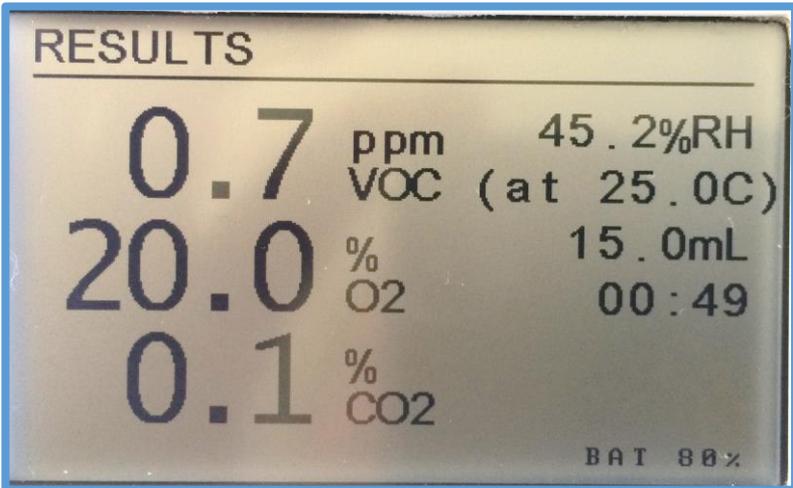
After the start button has been pressed, the pump will run until the sample volume (default: 15 mL) has been drawn into the F-950, and then the loop will close while the sample is analyzed. Maximum sample volume in fixed volume mode is 18.5 mL. Minimum sample volume is 10 mL for 5-10% accuracy.



When the loop is closed the F-950 system should be disconnected from the sample. The unit will read "Processing..." after the fixed volume is drawn inside the unit. Once processing is seen on the display, disconnect from the sample while the sensors analyze the fixed volume sample and provide the results.



The final result is then displayed on a new screen. The values listed are the concentrations of  $C_2H_4$ ,  $CO_2$ , and  $O_2$  present in the sample. To the right of the concentrations, are the relative humidity, temperature, volume of sample, and duration to collect and analyze sample.



Press the start button to return to the measurement screen. Connect to the next sample and press the start button to begin another measurement.

### Auto-Escape Feature

An upper limit auto-escape feature acts as a safety feature of the unit. This safety feature is always on. If the sensor detects **over 200 ppm** ethylene, the F-950 will auto-escape from monitor mode to prevent poisoning the electrode in the ethylene sensor. This will stop the measurement.

If the sensor becomes poisoned, it will continually auto-escape with the error message "**sensor out of bounds**". If this message appears, connect the external conditioning tube filled completely with potassium permanganate ( $\text{KMnO}_4$ ) to the inlet/outlet of the F-950. Allow time with the instrument powered on (Continuous Mode) to remove the high concentration of ethylene in the instrument.

## Setup

Use the right arrow to enter the Setup Menu from the Main Menu screen.

The F-950 has a number of utility functions that allow the user to manage the instrument's capabilities. Five setup functions are available: Mode, Calibration, Set Zero, Date & Time and RH Conversion.

### Setup Mode

Setup Mode allows the user to change the measurement mode of the instrument between Continuous, Trigger, and Fixed Volume mode. To change the mode, highlight Measure and use the right arrow to highlight the mode. Then use the Up/Down arrows to cycle through the mode options. Use the left arrow to highlight Measure once the correct mode has been selected. Then press the left arrow again to exit to the main menu.



USB mode should be set to Mass Storage. Virtual COM is the other mode, and should only be used to update the firmware if instructed by a Felix Instruments technician.

## Setup Calibration

Setup Calibration lists the C<sub>2</sub>H<sub>4</sub> Offset, C<sub>2</sub>H<sub>4</sub> Gain, Internal Volume, Fixed Volume, and Flow Rate. The C<sub>2</sub>H<sub>4</sub> Offset, C<sub>2</sub>H<sub>4</sub> Gain, Internal Volume values are set during calibration at Felix Instruments, and should not be changed unless instructed by a Felix Instruments technician. At the factory, the ethylene sensor is calibrated at 0 ppm and 20 ppm, then verification at 10 ppm.

The Fixed Volume and Flow Rate may be changed to accommodate various applications, but this may affect the accuracy of the device. Flow rate is adjustable from 40-120 mL/min. Fixed volume sample size is adjustable up to 18.5 mL.

**The default Fixed Volume is 15 mL. The default Flow Rate is 67 mL/min.**

| Calibration     |         |
|-----------------|---------|
| C2H4 Offset     | 0001672 |
| C2H4 Gain       | 0000545 |
| Internal Volume | 016.2   |
| Fixed Volume    | 15.0    |
| Flow Rate       | 067     |

## Setup Set Zero

Setup Set Zero sets a new baseline, or zero, for the  $C_2H_4$  sensor. This should be done **daily**. To set a new zero, first connect the external conditioning tube filled completely with potassium permanganate ( $KMnO_4$ ) to the inlet and use the “male to male adapter” to connect to the outlet of the F-950. Then use the right arrow to enter Set Zero.

Always allow the instrument adequate time to warm up (3 min) with the  $KMnO_4$  attached before setting the zero.



Always store the  $\text{KMnO}_4$  air tight by connecting the ends of the tubing. Replace the cotton ball filters at either end of the external conditioning tube each time the  $\text{KMnO}_4$  is replaced (color indicator turns from purple to brown when it expires).

The instrument will run an automated process that sets a new baseline for future measurements. A reminder to use connect the potassium permanganate appears.

Zero C2H4 Sensor

Use  $\text{KMnO}_4$  filter

C2H4 offset.....1349.1

After the Set Zero routine is finished, it will exit to the Setup menu. Next, **verify** the set zero calibration by measuring the  $\text{KMnO}_4$  (0 ppm). Run the set zero calibration again if verification is not successful.

## Setup Date and Time

Use the Right and Left arrows to move between Month/Day/Year and Hour/Minute/Second and use the Up and Down arrows to change the values. To exit, use the left arrow to back out of the screen and return to the Setup menu.



## Setup RH Conversion

The Setup RH Conversion menu is used to correct for the temperature sensor being inside F-950 housing. This causes the temperature sensor to reflect the temperature of the F-950 and not the ambient temperature. The temperature is usually several degrees above ambient. The Relative Humidity is calculated based on temperature.

Enter the correct ambient temperature in degrees Celsius, measured from an external temperature sensor, to have the F-950 use for calculating the relative humidity (RH %). To use the entered temperature for RH, “use sample T” should be set to “Yes.”

The current (internal RH) and corrected (sample RH) relative humidity are displayed at the bottom of this screen.

| RH Conversion                      |      |
|------------------------------------|------|
| Enter Sample T(C)                  | 20.0 |
| Use Sample T<br>(for measurements) | Yes  |
| Internal RH (%)                    | 43.6 |
| Sample RH (%)                      | 21.3 |

## Setup GPS

The GPS sensor inside of the F-950 can be used to record latitude and longitude to within 10 meters. The instrument should be operated outside, without overhead obstruction for best GPS performance. It may be difficult to acquire a fix on GPS satellites indoors. The Setup>GPS menu turns on or off the GPS sensor and show the current GPS data. Data is also saved to the SDcard .csv file.

| Setup GPS               |         |
|-------------------------|---------|
| Enable GPS              | Yes/No  |
| Acquiring GPS data..... |         |
| Longitude               | 122.558 |
| Latitude                | 45.59   |

## File

The File Menu is accessed by highlighting “File” on the Main Menu and pressing the right arrow key. Here, the user can manipulate files on the F-950.

In the main file menu, four options are available: Select, New, Delete and Review. All files created by the F-950 are .csv (comma separated value) files.

To view data on a computer, simply insert the SDcard into the computer’s SDcard reader. The computer should automatically detect the SDcard as a new storage device and mount the drive so that measurement data will be accessible by any computer application. The mini-USB port can also be used to establish a USB connection with a computer to transfer data from the F-950.



## File Select

File Select displays a list of .csv files that exist on the F-950 SD card. Use the Up and Down arrows to move between files, and the right arrow to select a file to which new data will be saved. If the unit is powered on and no file is selected, the data will be default saved to the file "data.csv". In the file, each data point is labeled with time and date for easy sorting.



## File New

Pressing the Right arrow when File New is selected will create a new file according to the naming scheme programmed on the instrument, XX\_XX\_XX\_X or Year\_Month\_Date\_Ordinal. For example, the first file created on September 8, 2014 will read 14\_09\_08\_0 and subsequent files will increase the last

placeholder numerically. After pressing the right arrow, go to File Select to see the list of files on the SDcard. There will be a new file in the list with the current date.

## File Delete

File Delete displays a list of files that exist on the F-950 SDcard. Use the Up and Down arrows to scroll between files and use the right arrow to display the option to delete the selected file. A message will appear that reads “Delete File?” Press the Left arrow for No, leaving the file intact. Press the Right arrow for Yes, deleting the file.



## File Review

File Review displays a list of files that are on the SD card and allows you to view the data in the files. Use the Up and Down arrows to scroll between files and the right arrow to enter the selected file. The data.csv file is the default file, which data will be saved into if no other files are created.

After selecting a file name, the measurement mode with time of the measurement and ethylene concentration will appear for Fixed Volume or Trigger mode readings. Use the Up and Down arrows to highlight a measurement and the Right arrow to enter the measurement and see the more detailed data, including CO<sub>2</sub>, O<sub>2</sub>, Temperature, Relative Humidity and Flow Rate.



## Data Files on the Computer

Open the data files saved on the SDCard on the computer using Microsoft Excel or Notepad. Data files are saved as .csv (commas separated value). The following figure is an example data spreadsheet. Data values included are the date and time of the measurement, the measurement mode, the ethylene level in parts per million (ppm), the CO<sub>2</sub> concentration in percent, the O<sub>2</sub> concentration in percent, the temperature of the gas stream in degrees Celsius, the relative humidity (RH) of the gas stream in percent, and the flow rate of the gas stream in milliliters (mL) per minute.



**REMEMBER:** Always save the data files to the computer before making changes or starting analysis.

| Date      | Time     | Mode       | C2H4(ppm) | CO2(%) | O2(%) | Temperature C | RH(%) | Flow(mL) | Longitude | Latitude |
|-----------|----------|------------|-----------|--------|-------|---------------|-------|----------|-----------|----------|
| 6/12/2015 | 11:42:32 | Continuous | 0.1       | 21     | 0.08  | 28.3          | 26.3  | 45.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:33 | Continuous | 0.1       | 21     | 0.08  | 28.3          | 26.3  | 53.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:34 | Continuous | 0.1       | 21     | 0.08  | 28.3          | 26.3  | 62.1     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:35 | Continuous | 0.1       | 20.9   | 0.08  | 28.3          | 26.3  | 68.9     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:36 | Continuous | 0.1       | 20.9   | 0.08  | 28.3          | 26.3  | 70.8     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:37 | Continuous | 0.2       | 20.8   | 0.08  | 28.3          | 26.3  | 69.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:38 | Continuous | 0.3       | 20.8   | 0.08  | 28.3          | 26.3  | 66.9     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:39 | Continuous | 0.8       | 20.7   | 0.08  | 28.3          | 26.3  | 67.9     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:40 | Continuous | 0.8       | 20.7   | 0.08  | 28.3          | 26.3  | 66       | 122.49    | 45.59    |
| 6/12/2015 | 11:42:41 | Continuous | 0.8       | 20.7   | 0.08  | 28.3          | 26.3  | 71.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:42 | Continuous | 0.8       | 20.6   | 0.08  | 28.3          | 26.3  | 69.4     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:43 | Continuous | 0.8       | 20.6   | 0.08  | 28.3          | 26.3  | 64.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:44 | Continuous | 0.8       | 20.6   | 0.08  | 28.3          | 26.3  | 71.5     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:45 | Continuous | 0.8       | 20.6   | 0.08  | 28.3          | 26.3  | 64.2     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:46 | Continuous | 0.8       | 20.5   | 0.07  | 28.3          | 26.3  | 64.2     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:47 | Continuous | 0.8       | 20.5   | 0.07  | 28.3          | 26.3  | 65.1     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:48 | Continuous | 1.2       | 20.5   | 0.07  | 28.3          | 26.3  | 62.5     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:49 | Continuous | 1.2       | 20.5   | 0.07  | 28.3          | 26.3  | 69.8     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:50 | Continuous | 1.2       | 20.5   | 0.07  | 28.3          | 26.3  | 63.4     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:51 | Continuous | 1.2       | 20.4   | 0.07  | 28.3          | 26.3  | 63.8     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:52 | Continuous | 1.3       | 20.4   | 0.07  | 28.3          | 26.3  | 70       | 122.49    | 45.59    |
| 6/12/2015 | 11:42:53 | Continuous | 1.3       | 20.4   | 0.07  | 28.3          | 26.3  | 68.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:54 | Continuous | 1.3       | 20.4   | 0.07  | 28.3          | 26.3  | 78.6     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:55 | Continuous | 1.3       | 20.3   | 0.07  | 28.3          | 26.3  | 72.8     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:56 | Continuous | 1.5       | 20.3   | 0.07  | 28.3          | 26.3  | 69.9     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:57 | Continuous | 1.6       | 20.3   | 0.07  | 28.3          | 26.3  | 73       | 122.49    | 45.59    |
| 6/12/2015 | 11:42:58 | Continuous | 1.8       | 20.3   | 0.07  | 28.3          | 26.3  | 64.9     | 122.49    | 45.59    |
| 6/12/2015 | 11:42:59 | Continuous | 2.1       | 20.3   | 0.07  | 28.3          | 26.3  | 72.5     | 122.49    | 45.59    |
| 6/12/2015 | 11:43:00 | Continuous | 2.5       | 20.3   | 0.07  | 28.3          | 26.3  | 68.3     | 122.49    | 45.59    |
| 6/12/2015 | 11:43:01 | Continuous | 2.9       | 20.4   | 0.07  | 28.3          | 26.3  | 64.7     | 122.49    | 45.59    |

Example spreadsheet data of an F-950 measurement.

## Firmware Update

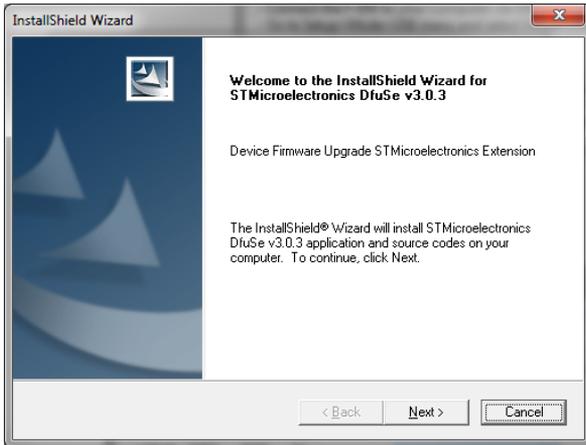
For the latest version of firmware, update software, and instructions, visit the F-950 Support webpage (<http://www.felixinstruments.com/support/f-950-support>).

To update the firmware, you will need:

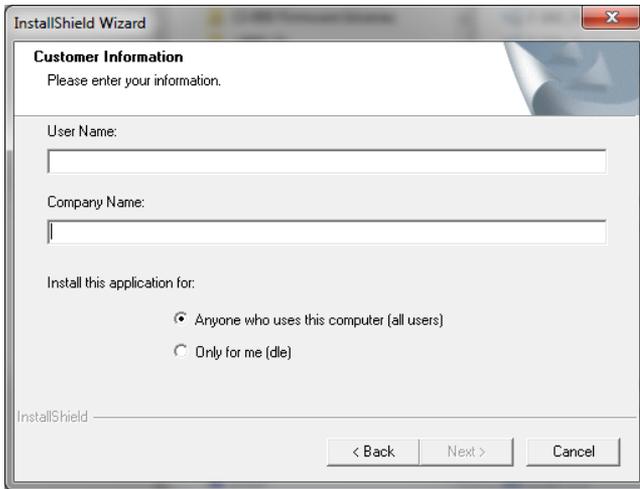
1. F-950\_Package\_Setup32.exe (or F-950\_Package\_Setup64.exe, under Windows 64 bit)
2. Firmware code file: FW\_950\_v.X.X.X.X.dfu
3. Mini-USB to USB cable to connect to F-950 to PC.

## Installing the F-950 Driver

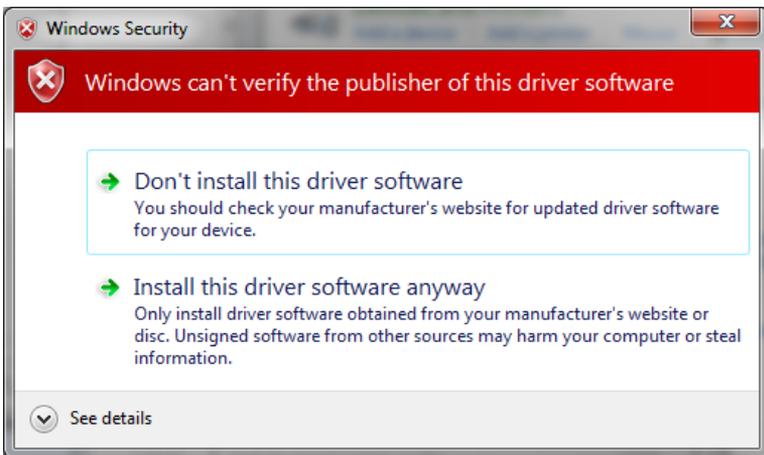
1. Launch F-950\_Package\_Setup.exe.
2. Set up device by powering on the F-950 and connecting it to computer via USB port. Go to Setup>Mode>USB menu and select Virtual COM.
3. Install will prompt for DfuSe tool (required for firmware upgrade).



4. Click Next, then enter your information into the window below. Click Next in the next several steps.



5. If Windows prompts the following message, select "Install this driver software anyway":



6. Device drivers and Software package installation is completed. Under Windows's Start menu, you should be able to find shortcuts for Device's Controller and Firmware Upgrade Program.

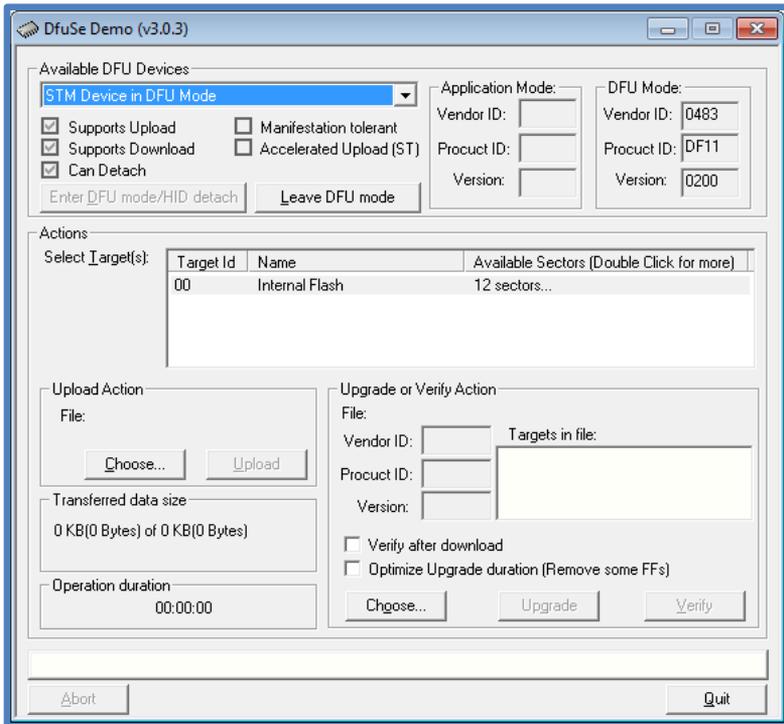


7. F-950 Controller software requires Java runtime environment. Installer will check for appropriate version on your computer. Please download and install Java at <http://www.java.com/> if requested.

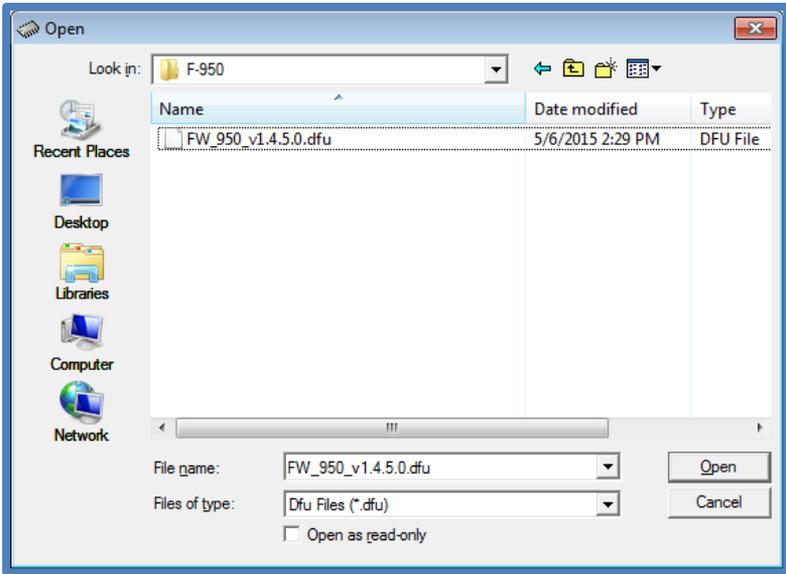
## Updating the Firmware

1. Download latest firmware (.dfu file) from Felix Instruments website:
  - a. <http://www.felixinstruments.com/support/f-950-support/software>
2. Open the F-950 Firmware Upgrade software.
3. With the unit powered off, connect the F-950 to the computer using the mini-USB to USB cable.
4. Hold the Down Arrow button down on the F-950, then press the Power button, then release both buttons. This puts the F-950 in DFU mode.
5. On the DFU software, from the drop down menu under "Available DFU Devices", select "STM Device in DFU

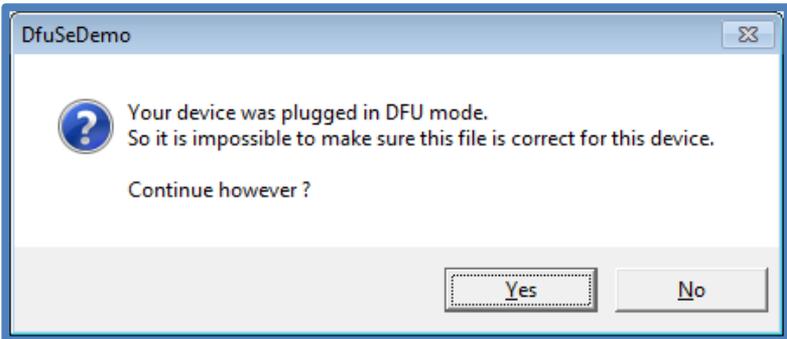
Mode”. Note: when connecting device to your computer for the first time, it may take a minute for the device to show up in the drop down menu.



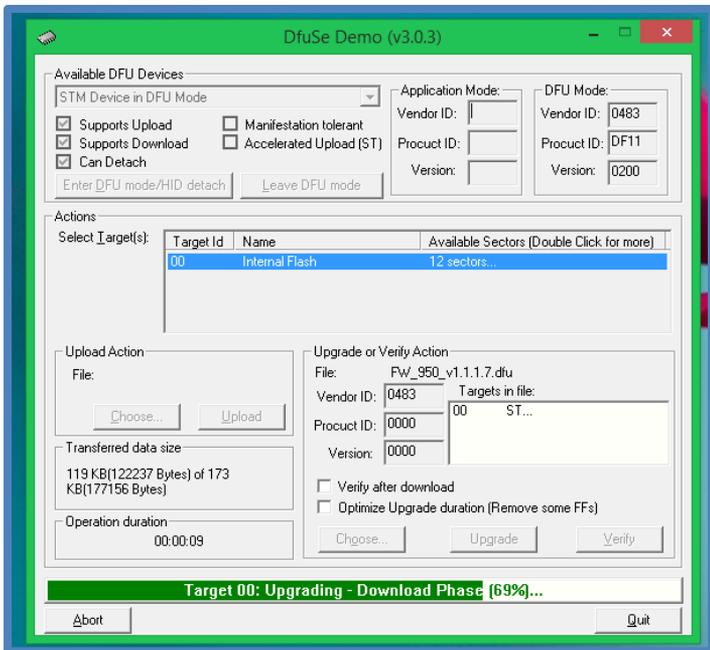
6. At the bottom of the transfer software screen, click “Choose...”.
7. A dialogue box labeled open will appear. Navigate to the desktop of your computer and select the new .dfu firmware file to download.



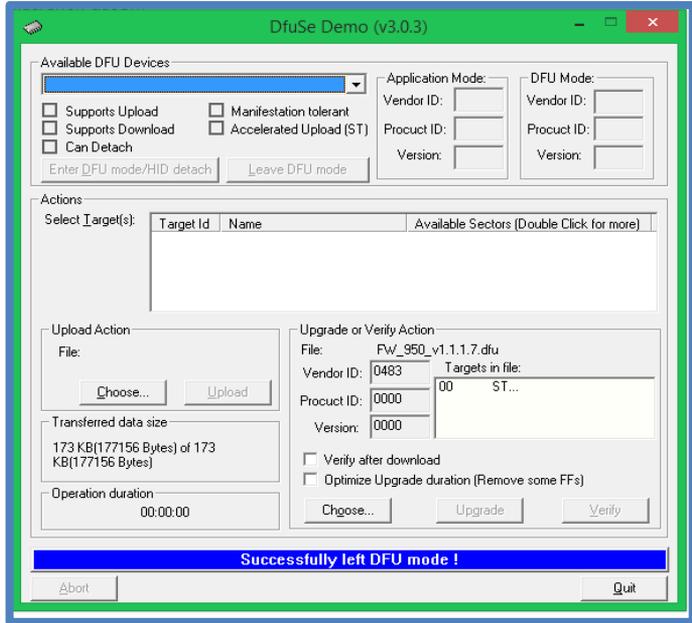
8. Click "Upgrade". A dialogue box will appear- click "Yes" to proceed.



9. The device is now being updated with the newest firmware. The green bar at the bottom of the screen tracks the progress of the upgrade. When the green bar reads “Upgrade successful” the process is complete.



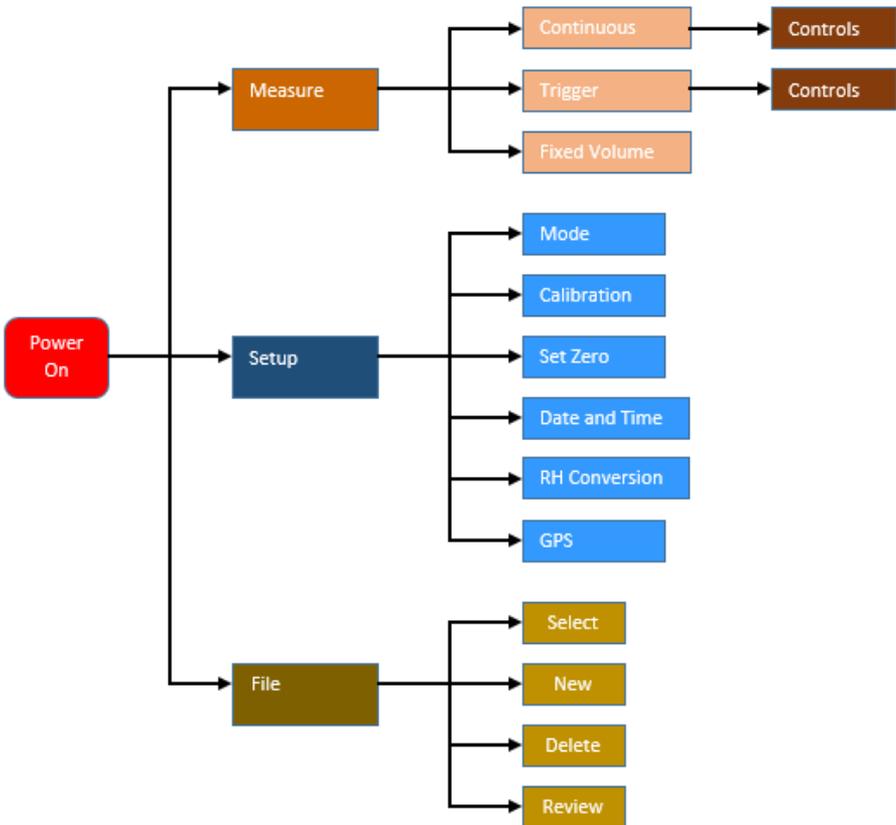
10. Near the top of the DFU program, click “Leave DFU mode” to return the device to its normal mode of operation.



11. Power on the F-950. In the lower right hand corner of the device screen, the new version of firmware will appear.

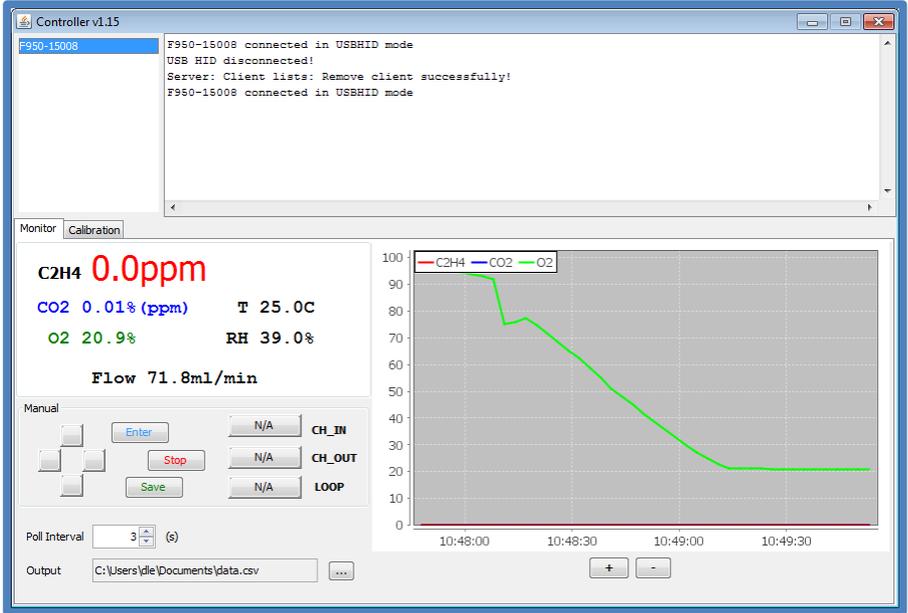
## F-950 Menu System Diagram

Below is a map of the F-950 ethylene analyzer menu system.  
Press the right arrow to enter a menu and the left arrow to exit.



## Appendix I: F-950 Controller Software

The F-950 Controller software offers real-time monitoring, controlling as well as calibrating multiple F-950/F-900 devices from standard USB connection.



### Instructions:

1. Open the F-950 Controller software
2. Connect the F-950 to the computer using the mini-USB to USB cable.
3. In F-950 device Setup>Mode>USB menu, select **Controller** mode.

4. In Controller software, the device series should show up in the device list at top-left corner. Click on the device series to select device. *Note: when connecting device to your computer for the first time, it may take a minute for the device to show up in the left panel.*
5. Monitoring information from your device should display in monitor tab.

## F-950 Production Test Check Sheet

|                   |
|-------------------|
| SERIAL NUMBER:    |
| Firmware Version: |

| C2H4 CALIBRATION PARAMETERS |  |
|-----------------------------|--|
| C2H4 Offset                 |  |
| C2H4 Gain                   |  |
| Internal Volume             |  |
| Fixed Volume                |  |
| Flow Rate                   |  |

NOTES:



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Phone: (360) 833-8835

[sales@felixinstruments.com](mailto:sales@felixinstruments.com)

[www.felixinstruments.com](http://www.felixinstruments.com)

## Warranty Registration Card



1554 NE 3<sup>rd</sup> Ave, Camas, WA 98607, USA  
Phone: (360) 833-8835 Fax: (360) 833-1914 e-mail: sales@felixinstruments.com Web: www.felixinstruments.com

### PRODUCT REGISTRATION CARD

Please complete and return this form to Felix Instruments within 30 days to validate your Warranty on Parts & Labor.

#### Registration Information:

Your Name: \_\_\_\_\_ Title: \_\_\_\_\_

Company/University: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Country: \_\_\_\_\_ Email \_\_\_\_\_

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

Felix Instruments Serial Number(s): \_\_\_\_\_

Purchase Date: \_\_\_\_\_ Purchase Price: \_\_\_\_\_

-----  
**FOLD ON DOTTED LINE**

Your opinions will help improve our service. Please answer the following questions.

#### 1. What was the basis of your product selection?

- Representative Recommendation
- Product Features
- Technical Specifications
- Warranty
- Other \_\_\_\_\_

- Price
- Product Design
- Brand Name
- Service

#### 2. What other competing brands did you consider? \_\_\_\_\_

#### 3. Where did you first learn of this product?

- Advertisement in \_\_\_\_\_
- Friend/Colleague \_\_\_\_\_
- Other \_\_\_\_\_

- Representative
- Exhibit

#### 4. Who selected this product?

- I did
- University Department \_\_\_\_\_
- Other \_\_\_\_\_

- Research Group
- Purchasing

#### 5. Comments/Suggestions: \_\_\_\_\_