SAFView Host Software

for SAFire

User's Guide

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1. Introduction

The SAFire host software, SAFView, is a comprehensive package that provides real-time data collection and display functions. SAFView receives data from the meter on a standard serial port, applies calibration values, displays data to the screen, and saves corrected data to a standard ASCII file.

Raw data can also be read from disk, as well as previously collected ASCII archive files. The raw data display functions is useful for processing extracted files from the WET Labs' MODAPS and Super MODAPS systems.

SAFView is completely configurable. A full selection of viewing options, such as sample rate, emission and excitation selection, and graph types are available.

SAFView is developed using the National Instruments Lab Windows package. This provides a clean graphical user interface with a good set of external functions. SAFView is best used with a mouse, but can be keyboard-operated if needed.

The SAFire instrument is capable of sending large amounts of data in a short time. Six excitation wavelengths and 18 emission wavelengths, plus other data make for a large influx of data.

SAFView is capable of displaying all the information it receives at once, but it is not practical to interpret this data in real time. To solve this problem, SAFView offers the capabilities of selecting which excitation and emission wavelengths are displayed.

In addition to controlling the amount of information displayed, SAFView offers four types of graphs:
1. Fluorescence versus Wavelength
2. Fluorescence versus Time
3. Fluorescence versus Depth
4. Fluorescence/Time strip chart

SAFView also will work with a WET Labs MPak3 data logger and profiler.

1.1 Minimum System Requirements

- 80486DX 33 Mhz Computer or better (a math co-processor is required)
- Color VGA display
- 4 MB RAM
- RS232 serial port capable of 19,200 baud
- 3 MB Disk space
- Mouse
- MS-DOS 5.0 or better

2. Installation

For this installation example, it will be assumed that installation is taking place from the A: drive. If the target system uses a different letter for the floppy drive, substitute the necessary letter for A. All commands must be followed by the enter or return key.

It will also be assumed the target directory is on the "C:" drive, and that directory is named "SAFVIEW".

Insert the floppy disk into the appropriate drive. From a DOS prompt, change to that drive by typing: "A:." Once the "A:\" prompt is on the screen, type the command "INSTALL C:\SAFVIEW".

This command will now start copying the necessary SAFView files into the SAFVIEW directory on the "C:" hard drive.

When the installation is finished, remove the floppy disk, and change back to the "C:" drive by typing "C:".

2.1 SAFView Basics

To start SAFView, change to the SAFView directory by typing "CD C:\SAFVIEW". Then, enter "SAFVIEW" to start the program.

When SAFView is started, the screen in Figure 1 will appear. This screen controls the SAFire meter, and displays the collected data.

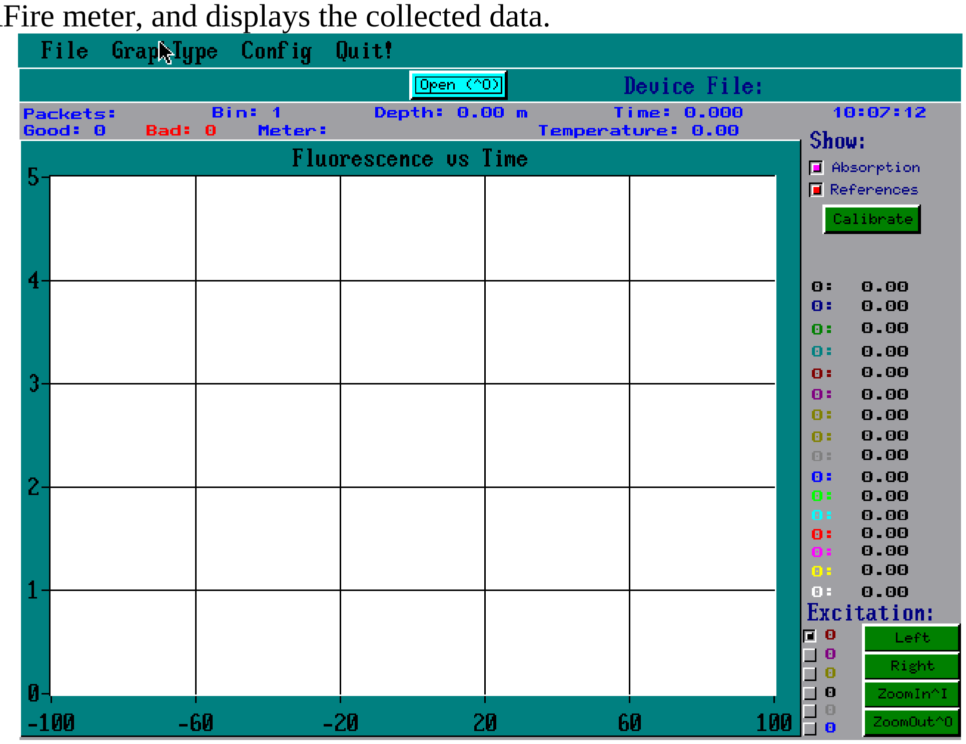

Figure 1. SAFView starting screen.

The menus on the menu bar at the top of the screen can be “pulled down” by moving the mouse pointer up to them, and pressing the left mouse button. From the keyboard, use ALT-F to view the pull-down menus.

File Menu
File operations are controlled from this menu. Four options are available:
1. Open Device
2. Save Device
3. Save Archive
4. About, and Quit

These options can be selected by displaying the menu, pointing to the options and then pressing the left mouse button. On a keyboard, the arrow keys will highlight an option.

GraphType Menu
Four graph types are available. See the Graphing Options section below for more detail.

Config
Configuration options for the instrument and SAFView can be set from this menu. See below for specifics.

MPak3Config
This option allows for optional configuration of the SAFire meter when it is used with the MPak3 data logger and profiler system. Refer to the MPak3 SAFire configuration section for more information.

Quit
This option immediately exits the SAFView software.

3. Data Collection

Before data collection can take place, a device file must be opened. A device can be opened two different ways: by selecting the Open button at the top of the screen, or using the open device function from the File menu.

When the open function is selected, a list of available device files is displayed. A device file contains information about a particular meter. All the calibration constants and user preferences are stored in this file. The contents of this file can be modified in the configuration screen. See the configuration section for more details.

Select the appropriate device file from the list of files. Be sure the file selected matches the SAFire meter currently being used. The calibration constants in a device file are specific to a certain meter.

After selecting the correct device file meter, a menu will appear requesting the input data port. If a functioning meter is currently connect to a serial port, and is powered, select COM 1 or COM 2. To display data from a previously saved ".ARC" file (MODAPS, SMODAPS), select the Archive button. If raw binary data is to be read (i.e. from a MODAPS.EXT file), use the raw function.

If COM1 or COM2 is selected, SAFView will try to read data from the selected serial port. This takes around 10 seconds. If all meter connections are correct, data will be displayed on the selected graph. If there is a problem receiving data, a time out message will be displayed after 15 seconds. Once an input port has been selected, that port will be used until a new device file is opened or the existing device file is reopened.

To adjust the graph during data collection, use the green Up, Down, Left, Right, Zoom in, or Zoom Out buttons on the lower right side of the screen. The Up, Down, Left and Right buttons move the viewing area of the graph in the selected direction. The Zoom buttons will magnify or de-magnify the traces.

If the graph is adjusted excessively during data collection, data packets may be lost, depending on system speed. To adjust the graph, considerable processor and graphics resources are needed. It is recommended that the desired graph adjustments be made in a test collection, prior to real data collection.

To stop data collection, select the red-colored "Stop" button at the top of the screen. When stop is selected, a file requester will appear, asking for the archive file name. This data file contains the collected values with any offsets that may be in the device file applied.

After collection is stopped, the graph may still be adjusted with the Zoom buttons. If the archive file originally was not saved, it can be saved later by selecting the Save Archive function under the file menu.

3.1 SAFView Internal Data Manipulation

Before saving data to the SAFView archive file, it is adjusted to provide useful values. The SAFire archive file contains excitation absorption values in inverse meters, fluorescence values in counts, depth in meters (if equipped), internal temperature in Celsius, and cast time.

When fluorescence data is received, several offset and reference factors are applied. The equation for the fluorescence manipulations is:

fluorescence value = (((scaling*counts)/over sample rate) * reference factor) + offset

Scaling is the received counts value multiplier. The SAFire sends all signal values as 16-bit numbers. Internally, the values are 32 bits. To retain 32-bit precision, a scaling factor is used.

Counts are the actual 16-bit values received from the SAFire. Internally to the SAFire, these values are 16-bit. The counts are divided by the scaling factor to obtain a 16-bit value for transmission.

Oversample rate is the number of analog to digital conversions made for each channel. A value is saved for each conversion. These values are summed for transmission to the host. At the receiving end, the number of counts is divided by the oversampling rate to derive the original signal value. Oversampling provides for a better signal-to-noise ratio.

Reference factor is equal to calibration reference divided by current reference. Values are generally near 1.0. This factor is used to compensate for aging characteristics of the flash lamp and optical path. The calibration reference factors are stored in the device file. The calibration option record new reference values.

Offset is used to adjust the calibrated values to a normalized value. This offset value is read from the device file. When calibrated at the factory, the offset values are set to produce zero counts with pure water being flowed through the meter. The calibration option normalizes the fluorescence values to zero.

The reference value is the oversample and scaling adjusted raw counts value generated by the reference detector.

To calculate the absorption value, the following equation is used:

$$\text{inverse meters} = (\text{offset} - \log(\text{sigval} / \text{refval}) / \text{path length}) * 1000$$

The offset value normalizes the output to zero inverse meters in clean water. This value is computed using the calibration option, and is stored in the device file.

The sigval is the scaling and over-sample corrected signal value received from the absorption detector.

The refval is the scaling and over-sample correct reference value received from the reference detector.

The pathlength is the optical length of the measurement path. This value is 25 centimeters for standard SAFire instruments.

The inverse meters are scaled by 1000 so the values appear on the graphical display at some readable level.

3.2 Calibration

A calibration control is provided on the measurement screen. This control will apply offset values to a specified device file thatwill normalize all fluorescence and absorption values to zero. The reference value is not adjusted with the calibration offsets.

To use the calibration function, collect several minutes of values with optically and ionically pure water. After stopping collection, select the calibration button. A requester will ask whether calibration is desired. Select “yes,” and a file requester will appear. Select the device file or create a device file for offset adjustment.

3.3 Graphing Options

3.3.1 Fluorescence versus Wavelength

This option shows fluorescence signal values on the Y-axis, and wavelengths on the X-axis. Each selected excitation is shown as a different color. If all six excitations are selected, with reference and absorption values, eight different colored traces will be displayed. This graphing option is also known as the spectral display.

The excitation control buttons on the lower right hand side of the screen controls what excitation wavelength for the emission values that are displayed along the right-hand side of the screen. This graphing option has the ability to show the most information at one time, since all excitation and emission values can be plotted at the same time.

3.3.2 Fluorescence versus Time

The type of graph plots time on the Y-axis, with signal values on the X-axis. Each different colored trace represents a different emission wavelength. This graph is meant for time profiling applications.

The excitation controls on the lower right control the excitation wavelengths for the emission values being plotted and displayed. Note that the color of the printed emission values matches the color of the plotted traces.

3.3.3 Fluorescence versus Depth

This graph is similar to the above type, except that depth is the Y-axis. Again, this graph type is intended for depth profiling applications and requires that an optional depth sensor be installed in your SAFire.

The excitation controls also determine which excitation is generating the emission values plotted on the graph, and displayed on the right hand side of the screen. The color of the traces corresponds to the color of the printed emission values.

3.3.4 Time Strip Chart

Time Strip Chart is a moving graph that plots time on the X-axis, and fluorescence signal values on the Y-axis. A single excitation set of emission wavelengths are plotted at a time. As the trace moves past the right side of the graph, the graph is scrolled, with the oldest values moving off the left side of the graph.

The excitation controls function exactly as profile graph types.

3.4 Configuration Options

Select the Config option from the main menu to access the Configuration screen in Figure 2.

The screen is divided into three control areas: excitation control, emission control, and graph control.

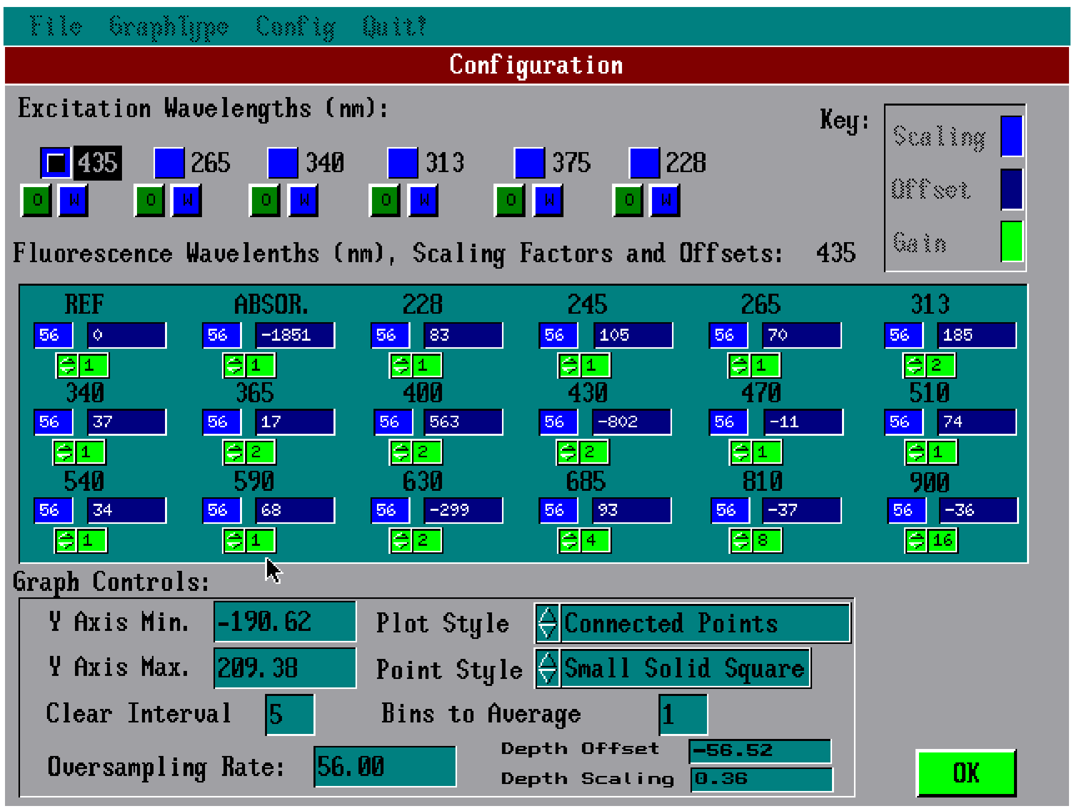

Figure 2. Configuration Screen

Caution!

Changing the scaling, offset, gain and oversampling values will cause the calibration values to be invalid. The SAFire will no longer be normalized to zero values in optically pure water.

3.4.1 Excitation Control

The excitation control area configures options based on excitation wavelength. The boxes on the left of the excitation wavelengths control whether a particular excitation plot is displayed on the Fluorescence versus Wavelength graph. If the blue box is checked, that series of emission values generated by that excitation is displayed.

The green box with an "O" below and right of the excitation value controls which emission values are shown for a particular excitation wavelength in the emission control area of the configuration screen. For example, if the "O" box below the 313 excitation were pressed the emission values for that excitation could now be configured in the emission control area.

The blue box with the "W" opens a window shown in Fig. 3. This window allows the user to select which emission wavelengths are displayed for a particular excitation. To select or de-select a particular emission, click in the blue box to the right of the emission value. When using a keyboard, use the tab key to move around the window, and the enter key to select or de-select a wavelength.

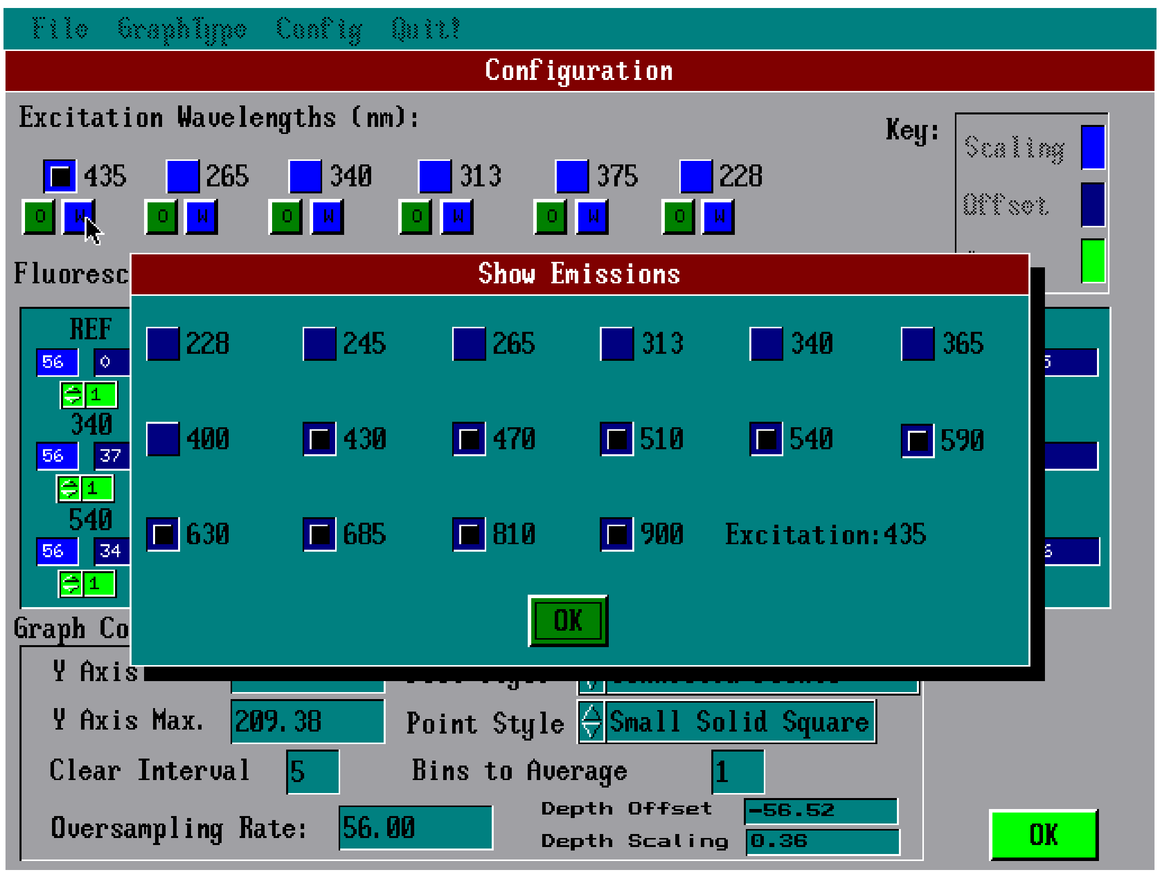

Figure 3. Show Emissions pop-up window

It is important to remember that this configuration window controls emission wavelengths on all four of the graph types. To exit this window, select the "OK" button.

If a device file is loaded, the configuration screen will display the values read from this file. All values that are displayed on the configuration screen are read from the device file. Changed configuration values can be saved to the device file under the Save Device option on the File menu. See the reference section for a description of the device file.

3.4.2 Emission Control

The emission control area of the screen controls configuration for an emission wavelength that is generated by an excitation wavelength selected in the excitation control area. The excitation value for the emissions is displayed to the right of the emission control area title.

Three important pieces of instrument configuration are controlled in this configuration section. Instrument configuration options are Scaling, Offset, and Gain.

Caution

The scaling, offset, and gain values sent to the SAFire greatly affect its performance. Exercise care when selecting these values.

The scaling factor controls the dynamic range of an emission channel for a given excitation. If an emission channel receives large fluorescence signal values, the scaling factor should be low. Conversely, small signals would need a larger scaling factor. Scaling values can be changed by clicking on the light blue box, and then entering in the new values. See the SAFire theory section for more information.

The offsets normalize values to a zero value. During factory calibration, optically pure water is flowed through the meters to normalize the signal values to zero. In field use, these values are usually not changed. To manually change these values, click on the dark blue box, and enter in new values.

Gain values set the electronic gain for each excitation/emission channel. These values control an electronic programmable gain unit in the SAFire meter. During factory calibration, the gain is set to a gain of “1”.

When measuring extremely small signals, the gain values can be increased for more sensitivity. On the other hand, when measuring extremely large signal values, the gain setting may need to be turned down. Large gain and signal values can cause the signal path electronics to saturate. Lowering the gain values will remedy this problem. Valid gain values are 1, 2, 4, 8, and 16. Gain values can be changed by pressing the down or up arrows next to the green displayed value box.

Changing either the scaling or gain settings will cause the normalized signal level to change. This means that the original offset values will no longer normalize to the original values. The SAFire will need to be re-normalized to the constant condition (Air, optically pure water, etc.).

3.4.3 Graph Control

The graph control area of the configuration screen controls display variables. The minimum and maximum Y-axis graph values, the clear interval, plot styles, binning, and oversample rate can be changed in this area of the screen.

The Y-axis values apply to the current graph mode selected—if the Fluorescence versus Wavelength graph is selected from the GraphType menu, the Y-axis will apply to that graph. Any values from -65535 to 65535 are valid. To change these values, click on the box and enter the desired values.

Clear interval controls the number of plots displayed before clearing the graph. The value is generally set to 5. This function only controls the number of excitation traces displayed before clearing on the Fluorescence versus Wavelength graph.

The oversampling rate is not really a graphing function. This value is sent to the instrument. Oversampling is the number of signal values that are taken for each signal channel for each measurement interval. The default value is 40 and should not be changed.

Oversampling rate is limited by the processor speed of the computer inside the meter. The higher the value, the better the signal-to-noise ratio and resolution. Entering an oversampling value that is too high will cause the meter to miss sampling signal channels. The factory-supplied value is near the maximum allowable value.

The point and plot values control the look of the graph traces. These values can be changed to suit the taste of the viewer. Adjustment of these values is accomplished by clicking on the down or up arrows on the left side of the box.

Bin to Average controls the number of sample to collect and average before saving to the archive file and plotting to the graph. This value can be any user-selected number up to 100.

4. Software Reference

The SAFView software was written in C, using the National Instruments Lab Windows libraries. It is linked as an embedded Lab Windows module.

This embedded module will work will all version of DOS beyond 4.0. SAFView will not work as an embedded module with Microsoft Windows 3.X and OS/2 Warp.

5. Device File Format

The device file is divided into several parts. Each part, or segment, of the device file has an identifying head, which is enclosed in brackets ([]).

The first couple lines of the file, under the “[identification]” head, give the name and serial number of the SAFire. The name is what appears at the top of the screen in SAFView, and the serial number tells the software what type of meter is being used.

WARNING

Do not change the serial number. Doing so will cause SAFView to operate incorrectly.

The next section, “[wavelengths]”, informs SAFView what wavelengths the instrument has installed, and what order they are sent. In this section and subsequent sections, the first six lines (0–5) are excitation values, the next two lines (A and B) are absorption and reference, and the rest of the lines are emission values (C to R).

The “[scaling]” section contains the scaling values for each channel. Values for the excitation wavelengths are ignored. These are the scaling values displayed in the configuration screen.

There are six offset sections. These contain all the emission offset values for each excitation channel. These are the offset values displayed in the configuration screen. The headings for the offset sections range from “[aoffset]” to “[eoffset]”. These offsets are set at the factory to normalize the meter signal values output to 0 in optically pure water.

Following the six offset sections is the show wavelength sections, “[showwave]”. A “1” in the emission line means that the particular emission channel will be displayed for that particular excitation. A “0” means that emission will not be displayed. Each emission line has six values, one for each excitation.

The following section is gain, with the “[gain]” heading. This section controls gain for each emission channel. Each emission channel line contains six characters. Each one represents a particular excitation channel. The values are A=1, B=2, C=4, D=8, and E=16. These values are the gain settings from the configuration screen.

The next section is entitled "[temperature]". The values here are not currently used.

The "[showexciation]" section saves the current set of excitation values that are selected for display on the graph. A "1" means an excitation is active. A "0" means the excitation is not displayed.

The final section of the device file contains various preference values for display options. Titles of each line describe the function. For example "spectral_ymax" controls the Y-axes maximum value for the Fluorescence versus Wavelength graph.

Example device file:

```
[identification]
name=   SAFire1
serialnumber=  F1000100
[wavelengths]
EX0=    435
EX1=    265
EX2=    340
EX3=    313
EX4=    375
EX5=    228
FLA=    100
FLB=    100
FLC=    630
FLD=    470
FLE=    685
FLF=    510
FLG=    810
FLH=    540
FLI=    900
FLJ=    590
FLK=    245
FLL=    228
FLM=    340
FLN=    265
FLO=    365
FLP=    430
FLQ=    400
FLR=    313
[scaling]
OEX0=   1.000
OEX1=   1.000
OEX2=   1.000
OEX3=   1.000
OEX4=   1.000
OEX5=   1.000
OFLA=   56.000
OFLB=   56.000
OFLC=   56.000
OFLD=   56.000
OFLE=   56.000
OFLF=   56.000
OFLG=   56.000
OFLH=   56.000
OFLI=   56.000
OFLJ=   56.000
OFLK=   56.000
OFLL=   56.000
OFLM=   56.000
OFLN=   56.000
OFLO=   56.000
OFLP=   56.000
OFLQ=   56.000
OFLR=   56.000
[aoffsets]
```

```
OSX0=   0.000
OSX1=   0.000
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   -1851.403
OSLC=   -299.762
OSLD=   -11.394
OSLE=   93.734
OSLF=   74.169
OSLG=   -37.015
OSLH=   34.970
OSLI=   -36.852
OSLJ=   68.940
OSLK=   105.964
OSLL=   83.437
OSLM=   37.565
OSLN=   70.436
OSLO=   17.066
OSLP=   -802.356
OSLQ=   563.293
OSLR=   185.382
[boffsets]
OSX0=   0.000
OSX1=   0.000
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   -64.518
OSLC=   -227.869
OSLD=   118.364
OSLE=   128.952
OSLF=   66.733
OSLG=   55.714
OSLH=   47.026
OSLI=   65.632
OSLJ=   75.976
OSLK=   99.282
OSLL=   72.475
OSLM=   45.550
OSLN=   58.180
OSLO=   81.146
OSLP=   52.134
OSLQ=   576.407
OSLR=   164.131
[coffsets]
OSX0=   0.000
OSX1=   0.000
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   -1957.668
OSLC=   -311.221
OSLD=   -38.445
OSLE=   96.851
OSLF=   -206.990
OSLG=   -38.986
OSLH=   -42.968
OSLI=   -38.857
OSLJ=   71.959
OSLK=   108.486
OSLL=   84.035
OSLM=   44.146
OSLN=   71.645
OSLO=   76.644
OSLP=   -47.380
OSLQ=   584.455
OSLR=   194.415
[doffsets]
OSX0=   0.000
OSX1=   0.000
```

```
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   -90.544
OSLC=   -229.447
OSLD=   121.159
OSLE=   126.104
OSLF=   68.404
OSLG=   49.289
OSLH=   43.901
OSLI=   57.579
OSLJ=   73.813
OSLK=   100.451
OSLL=   68.673
OSLM=   31.239
OSLN=   56.937
OSLO=   67.026
OSLP=   -27.545
OSLQ=   570.117
OSLR=   166.200
[eoffsets]
OSX0=   0.000
OSX1=   0.000
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   -1331.047
OSLC=   -274.462
OSLD=   102.750
OSLE=   109.812
OSLF=   -97.728
OSLG=   1.545
OSLH=   -664.743
OSLI=   -3.047
OSLJ=   73.673
OSLK=   107.558
OSLL=   77.735
OSLM=   42.730
OSLN=   68.256
OSLO=   87.434
OSLP=   51.782
OSLQ=   586.809
OSLR=   186.015
[foffsets]
OSX0=   0.000
OSX1=   0.000
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   -74.118
OSLC=   -223.419
OSLD=   121.183
OSLE=   132.872
OSLF=   70.171
OSLG=   60.390
OSLH=   51.053
OSLI=   69.842
OSLJ=   84.049
OSLK=   102.230
OSLL=   72.247
OSLM=   38.783
OSLN=   63.863
OSLO=   83.760
OSLP=   49.452
OSLQ=   593.684
OSLR=   198.139
[showwave]
OSX0=   11111
OSX1=   11111
OSX2=   11111
OSX3=   11111
```

```
OSX4=   11111
OSX5=   11111
OSLA=   11111
OSLB=   11111
OSLC=   11111
OSLD=   11111
OSLE=   11111
OSLF=   11111
OSLG=   11111
OSLH=   11111
OSLI=   11111
OSLJ=   11111
OSLK=   11111
OSLL=   11111
OSLM=   11111
OSLN=   11111
OSLO=   11111
OSLP=   11111
OSLQ=   11111
OSLR=   11111
 [gain]
OSX0=   00000
OSX1=   00000
OSX2=   00000
OSX3=   00000
OSX4=   00000
OSX5=   00000
OSLA=   00000
OSLB=   00000
OSLC=   00000
OSLD=   00000
OSLE=   00000
OSLF=   00000
OSLG=   00000
OSLH=   00000
OSLI=   00000
OSLJ=   00000
OSLK=   00000
OSLL=   00000
OSLM=   00000
OSLN=   00000
OSLO=   00000
OSLP=   00000
OSLQ=   00000
OSLR=   00000
[temperature]
OSX0=   0.000
OSX1=   0.000
OSX2=   0.000
OSX3=   0.000
OSX4=   0.000
OSX5=   0.000
OSLA=   0.000
OSLB=   0.000
OSLC=   0.000
OSLD=   0.000
OSLE=   0.000
OSLF=   0.000
OSLG=   0.000
OSLH=   0.000
OSLI=   0.000
OSLJ=   0.000
OSLK=   0.000
OSLL=   0.000
OSLM=   0.000
OSLN=   0.000
OSLO=   0.000
OSLP=   0.000
OSLQ=   0.000
OSLR=   0.000
[reference]
SEX0=   1
SEX1=   0
SEX2=   0
SEX3=   0
SEX4=   0
SEX5=   0
```

```
[showexcitation]
SEX0=   1
SEX1=   0
SEX2=   0
SEX3=   0
SEX4=   0
SEX5=   0
[config]
spectral_ymax= 209.380
spectral_ymin= -190.620
profile_ymax=  2.000
profile_ymin=  0.000
profile_xmax=  100.000
profile_xmin=  -100.000
strip_ymax=    2000.000
strip_ymin=    -2000.000
depth_ymax=    0.000
depth_ymin=    -99.000
oversamples=   56.000
clearinterval= 5
plotstyle=     1
pointstyle=    9
screenbin=     1
receivebin=    1
depth_scale=   0.360
depth_offset=  -56.520
graph_mode=    1
[]
```

6. Data File Format

The data file consists of two parts: a copy of the device file, and the data received from the SAFire. The device file format is outlined above.

At the start of the data segment (after the configuration information), a header with the titles for each column of data is printed. The header starts with reference and absorption for a certain excitation. The reference information is represented by the excitation frequency with a capital "R" appended. Absorption is the same, except with an "A" appended.

Both the header and data segments of the SAFire data file are separated with tabs. This allows spreadsheet programs to easily read these data.

After the header, actual data is stored. This data is represented in standard ASCII floating point text.

Example archive file:

(device file header)

```
Time    435R    435A    228     245     265     313     340     365     400     430     470
        510     540     590     630     685     810     900     265R    265A    228     245
        265     313     340     365     400     430     470     510     540     590     630
        685     810     900     340R    340A    228     245     265     313     340     365
        400     430     470     510     540     590     630     685     810     900     313R
        313A    228     245     265     313     340     365     400     430     470     510
        540     590     630     685     810     900     375R    375A    228     245     265
        313     340     365     400     430     470     510     540     590     630     685
        810     900     228R    228A    228     245     265     313     340     365     400
        430     470     510     540     590     630     685     810     900     Temp    Depth
        13:14:38
```

Revision History

Revision	Date	Revision Description	Originator
A	4/26/00	Begin revision tracking	H. Van Zee