



Painless Extraction User Manual

1001 Broad Street, Suite 450 • Utica, NY 13501 • Voice:(315) 735-4217 • Fax:(315) 735-4328
RAWood@rawood.com • www.rawood.com



Table of Contents

- Overview
 - Trial Version Limitations and System Requirements
 - Changes by Version
- Installing Painless Extraction
- Program Flow Diagram
- Data Extraction Diagram
- Getting Started
- Program Operation
 - Setup Tab
 - Import S2P File
 - Extract Data
 - Analyzer Specific Setup
 - Settings Files
 - Quick Plots Tab
 - Numeric Data Tab
 - Graphical Analysis Tab
 - Line Display Options
 - Marker Line Properties
- Statistical Analysis Tab
- Script File
- Test Results File
- S2P File
- Production Testing Mode
- Printing
- Help Menu
- Purchasing Information



Overview

Painless Extraction is a comprehensive program that automates the extraction of data from a Network Analyzer to your computer . This program will save extracted data to an S2P file and read existing S2P files for statistical analysis. Script files may be created or imported to perform quality assurance pass/fail testing.

Key Features:

- Retrieves S-parameters electronically from Network Analyzers.
 - We currently support Agilent 8720, 8753, 8757c, 8757d, 8757e and 8510.
 - Contact us for information on adding support for additional analyzers.
- Data analysis of each S-parameter vs. Frequency
 - Includes a graphical panel with plots, statistics, and a pass/fail report (all on the same page).
 - Print multiple plots with limits using a self contained macro to quickly generate test reports for each part.
 - Perform data analysis on the selected S-parameters using the following statistical calculations:
 - Average
 - Minimum
 - Maximum
 - P-P Flatness
 - RMS
 - Standard Deviation
 - Slope of Best Fit Line (BFL)
 - Minimum Deviation from BFL
 - Maximum Deviation from BFL
 - P-P Variation from BFL
 - Store and retrieve S-parameters from S2P data files.
 - Create, load, and save Script files to identify pass/fail points in the selected data.
 - Save a Test Results file to summarize the outcome of the pass/fail script file test.
- Interact with Painless Extraction Scriptor.
 - Utilize the capabilities of Painless Extraction in a scripting environment to automate the testing of multiple parts.
 - Include custom dialog prompts throughout the automated script to call attention to the tester.
- A great way to view S2P Files!
 - Flexible plotting routines.
 - A must for anyone using a Network Analyzer!

If you have any questions or comments please contact us at: (315) 735-4217 or rawood@rawood.com



Trial Version Limitations and System Requirements

- Trial Version
 - The trial version of Painless Extraction has all the features of the full version with a few limitations:
 - The ability to save data to a file is disabled.
 - The analysis frequency range is limited to 2750 - 2950 MHz.
 - The full version is available for purchase for \$349.00 (US Dollars). Buy now to unlock all program features.
- Compatible Network Analyzers
 - Agilent 8720 Series
 - Agilent 8510 Series
 - Agilent 8753 Series
 - Agilent 8757 c
 - Agilent 8757 d
 - Agilent 8757 e
- System Requirements
 - GPIB/HPIB Card
 - Network Analyzer and Computer require GPIB interfaces
 - Please Note: Software has been tested with National Instrument Cards only.
 - Painless Extraction was designed to operate in the Windows XP, Vista, and Windows 7 environments.



Changes by Version

Thank you for choosing Painless Extraction!

__ Current Version: 2.2.0 __

__ Changes in Version 2.2.0 __

Created Painless Extraction Scriptor, a new software package that interacts with Painless Extraction. This new program is up for download on our website. It enables you to script multiple extractions, create custom dialogs to call between extractions, and call external programs. For more information see our website www.rawood.com.

Added the ability to save multiple settings files for various test setups.

Improved the GUI appearance.

Added an optional display of the Test Results Table on the Graphical Analysis Tab for easy viewing and printing of results.

Added a Print Script column to the Statistical Script File. This allows the user to print multiple test results at the click of a button.

__ Changes in Version 2.1.8 __

Improved the GUI aesthetics.



Changes by Version Cont.

__ Changes in Version 2.1.7 __

Enhanced the features to create and save .ini settings files.

__ Changes in Version 2.1.6 __

Added an Automated Mode for production testing. Users can now set up their test and enter the automated mode for a variety of options to enable automated saving of data files and test analysis files, along with options to include serial numbers, product numbers, tester information, and date information in the saved file names.

Resolved the bug with the 8757 driver outputting an extra zero point after the extracted data.

GPIB commands have been changed to VISA commands to allow for more flexibility in GPIB device usage.

Added a control for including the GPIB Interface Number on the Setup Tab.

The auto scaling feature on the Graphical Analysis tab has been reworked. Auto scaling is now off by default. There is a new button on the left hand side that when hit will auto scale the graph once. This should allow for consistency in user defined scaling between data extractions.

A New Export to Excel feature was added to export the data from the Numeric Data tab to Excel.

__ Changes in Version 2.1.2 __

Separated support for the 8757c and the 8757e analyzers. These analyzers now have different output data formats.

__ Changes in Version 2.1.1 __

Resolved issues with the stat start freq and the stat stop freq on the Statistical Analysis tab.

__ Changes in Version 2.0.8 __

Updated the file IO to allow the user to cancel dialog boxes without erasing the current data. Updated dialog boxes to pop-up only when required. Altered the file loading and saving procedures to allow for the use of .scl file types. These files have the same format as .S2P files, but can be used to store data from scalar analyzers.

Added an option to save setup settings as default. These settings can then be loaded every time the software runs.



Changes by Version Cont.

__ Changes in Version 2.0 __

In this version, a Statistical Analysis tab was added. On this tab you may load and/or create script files to analyze data that has been extracted from the analyzer or loaded into the program from an S2P file. Using the script file parameters, a test results file is created to display pass/fail analysis of the data.

This version also adds the capability to change the default channel descriptions for the extracted data or data read from an S2P file. The S2P file now saves all the Setup information, including any changes made to the channel names.

Improvements were made for the Agilent 8757 C/E network analyzers. The original options for the earlier models of the 8757 are still included, but now the 8757 C/E has additional capabilities. This program will now extract the number of network analyzer points directly from the 8757 C/E. Data is also extracted from the 8757 C/E network analyzers exactly as it has been set up on the analyzer (measure, memory, and measure-memory). The channel names that are displayed reflect this setup. There is no longer a need to setup the program to use correction data for these analyzers. It does it automatically where appropriate.

Finally, we added context help for all the new and exiting features of this program. Easy instructions are available by going to Help->Show Context Help.

__ Changes in Version 1.6 __

Enhanced the registration process.

__ Changes in Version 1.5 __

Enhanced the registration process.

__ Changes in Version 1.4 __

In this version a few interface improvements were made for the Agilent 8720 and 8510 series network analyzers. We also added a control to "Hide Frequencies" on the Data Analysis tab. This is helpful in areas where displaying actual frequencies could be "sensitive".

__ Changes in Version 1.3 __

We've added the capability to extract S-parameters from the Agilent (HP) 8753 network analyzers, in addition to the Agilent 8720 and the Agilent 8510 network analyzers. Let us know which network analyzers you would like to see included.



Changes by Version Cont.

__ Changes in Version 1.2 __

Improved the registration process. You can now send payment by PayPal, online form, or e-mail. The user name and registration key are sent to us electronically, thereby making the registration process easier and less prone to error.

__ Changes in Version 1.1 __

We've changed our file format. We now save files and read them in the more popular "Touchstone S2P" format. If you have files in the previous format, please let us know and we can help you transfer the old files to the touchstone S2P format. The "read file" and "save file" menus have been moved to the File menu.

We've added the capability to extract S-parameters from the Agilent (HP) 8510 network analyzer, in addition to Agilent 8720 network analyzers. Let us know which network analyzers you would like to see included.

On the Data Analysis tab, we've added additional features to the plot. You can now drag cursors to the frequency region of interest. A "Zoom to Cursors" button zooms the graph to the cursors, and statistics are updated for data in the region between the cursors. A "Zoom Out" button expands the plot to the full frequency range.

We've added delta markers, where we show the frequency and amplitude difference between cursors.

Simplified and improved the user interface.

This program has the added capability of an S2P file viewer. Load in S2P files from vendors to see plots and statistics of the S-parameters over your desired frequency band.

As always, we appreciate your feedback. We continually strive to improve our software packages based on your suggestions.

We would like to thank you for choosing our product and for your continued support.

Enjoy Painless Extraction!

Bob Wood
President
R. A. Wood Associates
1001 Broad St. Suite 450
Utica, NY 13501
Voice: (315)735-4217
Fax: (315)735-4328
www.rawood.com
rawood@rawood.com



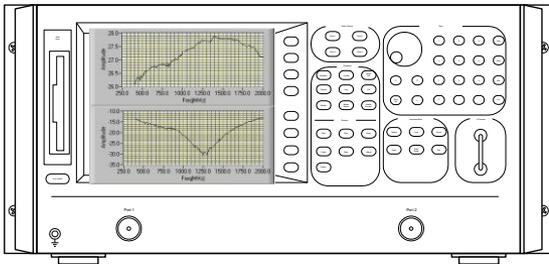
Installing Painless Extraction

- To check out Painless Extraction for yourself, visit the R.A. Wood Software Download page at: http://rawood.com/software_products/download_software_page.html
 - Select *Download Now!* next to the *Painless_Extraction_Installer_2_2_0.exe*
 - Click *Save File* to save the installer.
 - Browse to the desired save location and click *Save*.
- After the installer download is complete, double click on the *Painless Extraction Installer icon* to start the installation process. Then follow the Installer Wizard Prompts.
- For detailed screen shots of the installation process visit the software wiki (found in the software support section of our website).

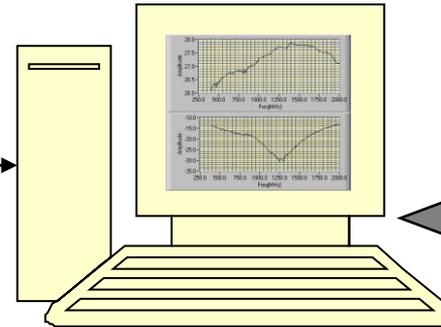


Program Flow Diagram

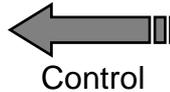
**Agilent 8720, 8753, 8757, or 8510
Network Analyzer**



PC Setup



← GPIB Cable →



→
Full S-Parameters
Retrieved from
Network Analyzer

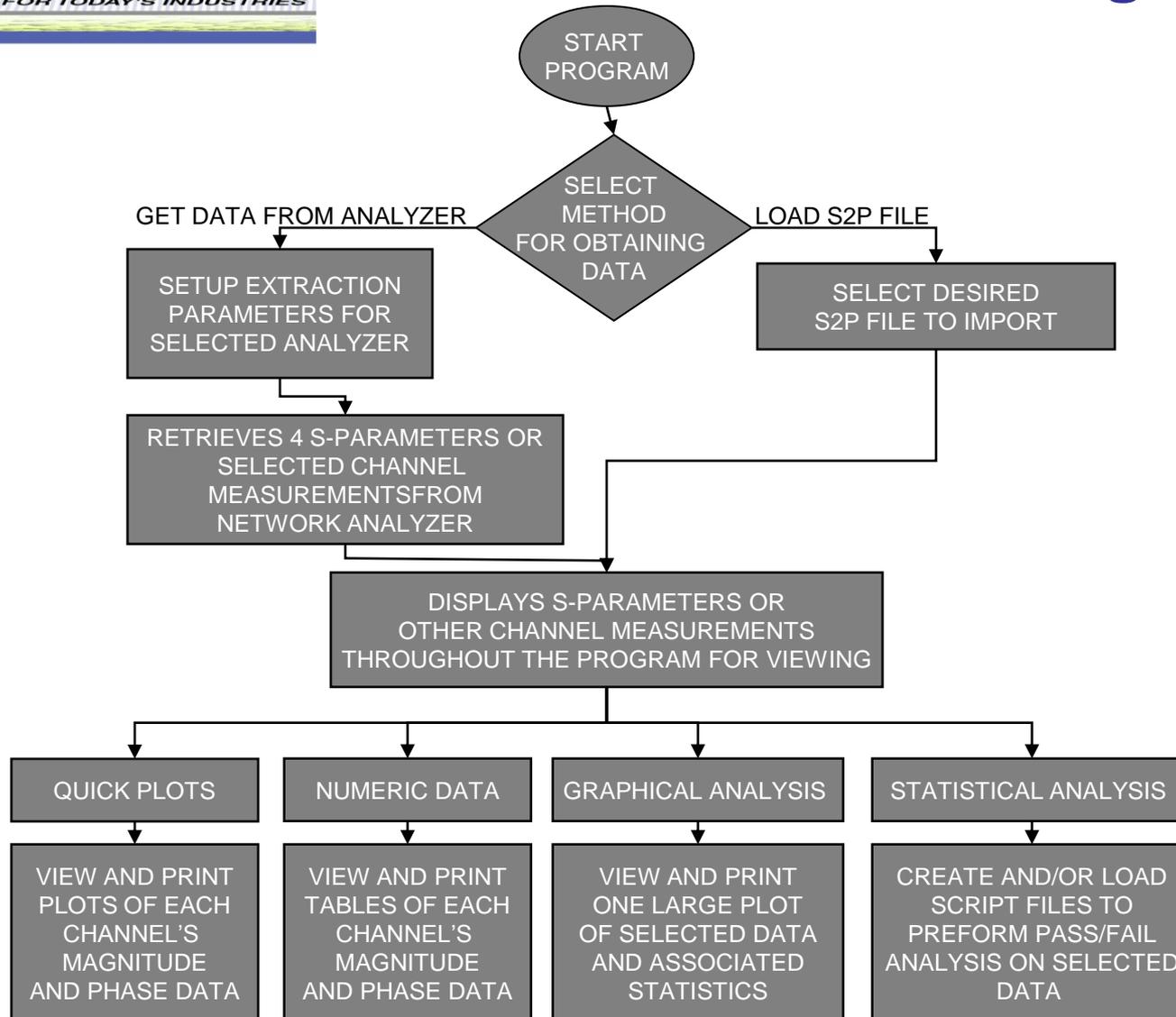


→
S-Parameters Stored In
S2P Data Files

←
S-Parameters Retrieved
from S2P Data Files



Data Extraction Diagram





Getting Started

Once Painless Extraction has been successfully installed (see Installing Painless Extraction for help) and opened, the screen below will appear on your computer. From this location, you may get started by setting up the parameters to extract data or select to import data from an existing S2P file.

To import data from a file:

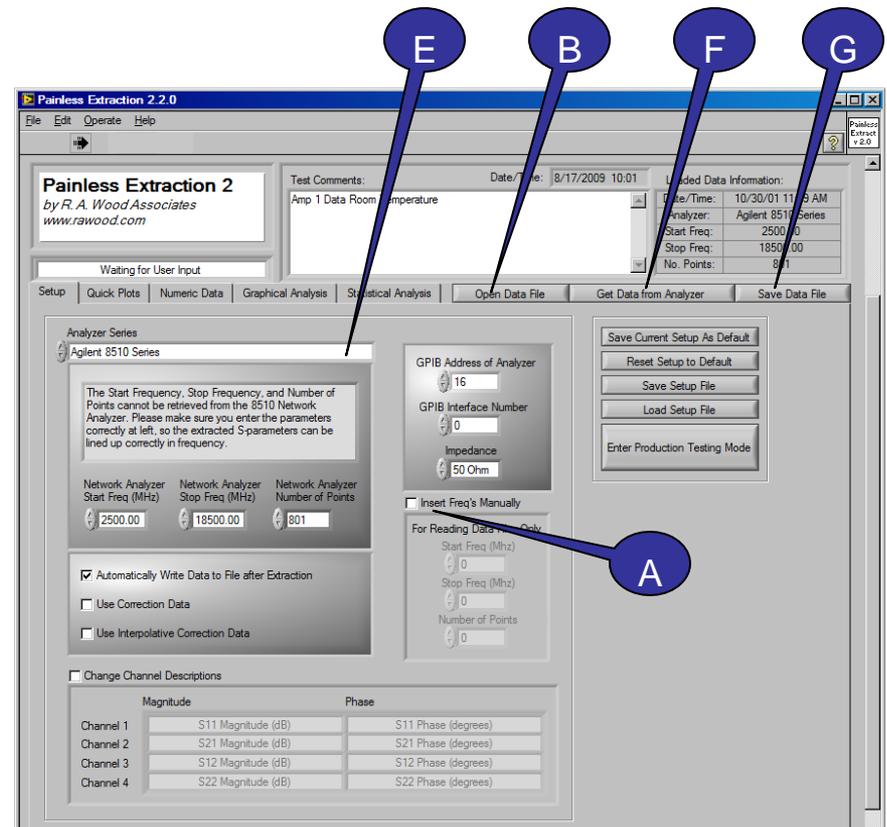
- A. If the S2P file does not contain start and stop frequency setup information, select **Insert Freq's Manually**.
 - Enter the setup information that was used to run the test.
 - This is not necessary for S2P files created with this program.
- B. Go to **File >> Open Data File...** or click on **Open Data File**

To extract data from an analyzer:

- C. Manually setup the analyzer as desired for the test.
- D. Connect the GPIB cable between the analyzer and the computer.
- E. On the Setup Tab, select the **Analyzer Series** that you are using, and fill in the associated setup parameters (see Setup Tab – Extract Data for more information).
- F. Click on **Get Data from Analyzer**

To save data to an S2P file:

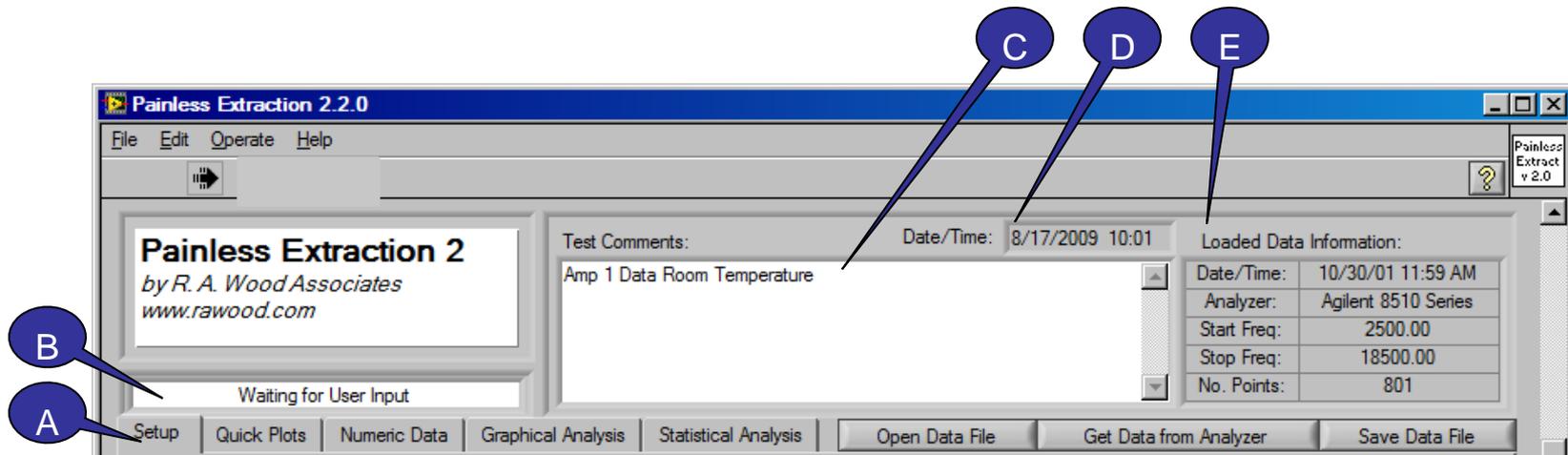
- G. Go to **File >> Save Data File...** or click on **Save Data File**



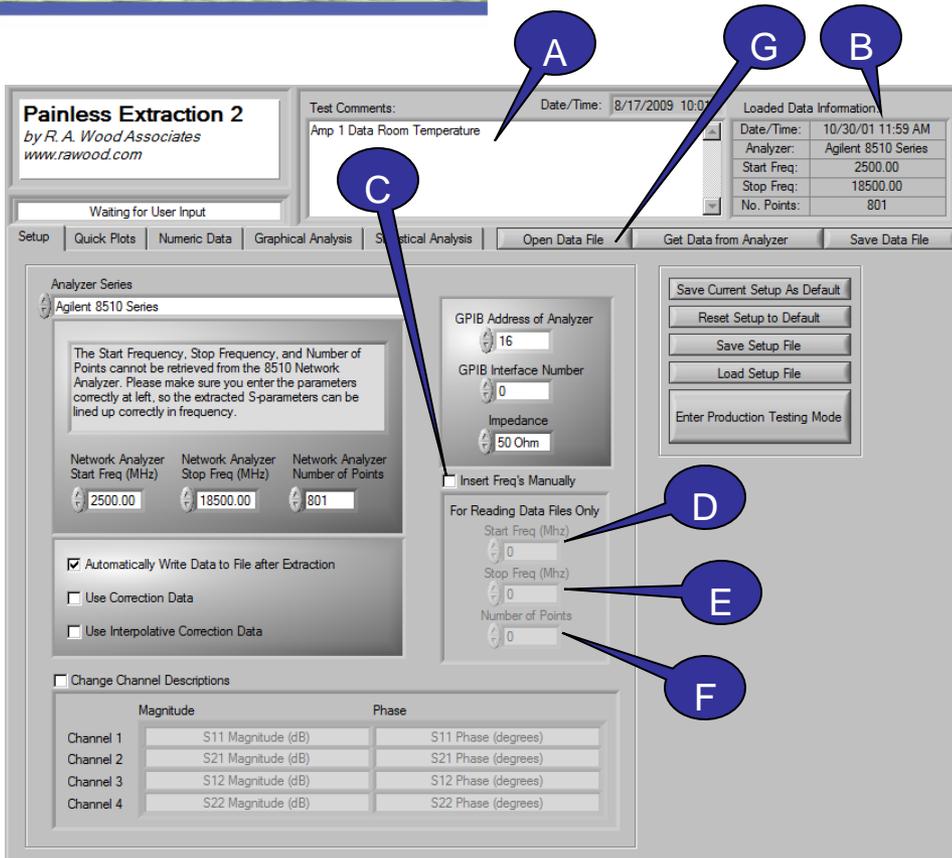


Program Operation

- A. This program is divided up into five tabs for easy navigation. At any time, you may select to view the *Setup Tab*, the *Quick Plots Tab*, the *Numeric Data Tab*, the *Graphical Analysis Tab*, and the *Statistical Analysis Tab* by simply clicking on the associated tab.
- **Setup** - Choose the analyzer series, enter the setup parameters, change the channel descriptions, and select various options for the output of data.
 - **Quick Plots** - The following eight plots are displayed: Channel 1 magnitude, Channel 1 phase, Channel 2 magnitude, Channel 2 phase, Channel 3 magnitude, Channel 3 phase, Channel 4 magnitude, and Channel 4 phase.
 - **Numeric Data** - Two data tables are displayed: Magnitude/Phase and Real/Imaginary
 - **Graphical Analysis** - A large plot and statistical analysis of the selected data is displayed.
 - **Statistical Analysis** - Use this tab to load and/or edit script files to be used for Pass/Fail analysis of data.
- B. Throughout the program operation, the **Status Bar** displays the current status of the analyzer and the program.
- C. Type **Test Comments** here to be added to the data file and printed with the test results.
- D. Displays the current **Date and Time**.
- E. **Latest Extraction Information** displays the setup parameters that were used during the last extraction or for the most recently opened data file.



Setup Tab – Import S2P File



The screenshot shows the 'Setup' tab of the Painless Extraction 2 software. Callouts A through G point to the following elements:

- A:** Test Comments field (containing 'Amp 1 Data Room Temperature')
- B:** Loaded Data Information table (containing Date/Time, Analyzer, Start Freq, Stop Freq, and No. Points)
- C:** Network Analyzer Start Freq, Stop Freq, and Number of Points input fields
- D:** Start Freq (Mhz) input field under 'For Reading Data Files Only'
- E:** Stop Freq (Mhz) input field under 'For Reading Data Files Only'
- F:** Number of Points input field under 'For Reading Data Files Only'
- G:** 'Open Data File' button

Loaded Data Information Table:

Date/Time:	10/30/01 11:59 AM
Analyzer:	Agilent 8510 Series
Start Freq:	2500.00
Stop Freq:	18500.00
No. Points:	801

Network Analyzer Parameters:

Network Analyzer	Network Analyzer	Network Analyzer
Start Freq (MHz)	Stop Freq (MHz)	Number of Points
2500.00	18500.00	801

For Reading Data Files Only Parameters:

Start Freq (Mhz)	Stop Freq (Mhz)	Number of Points
0	0	0

Channel Data Table:

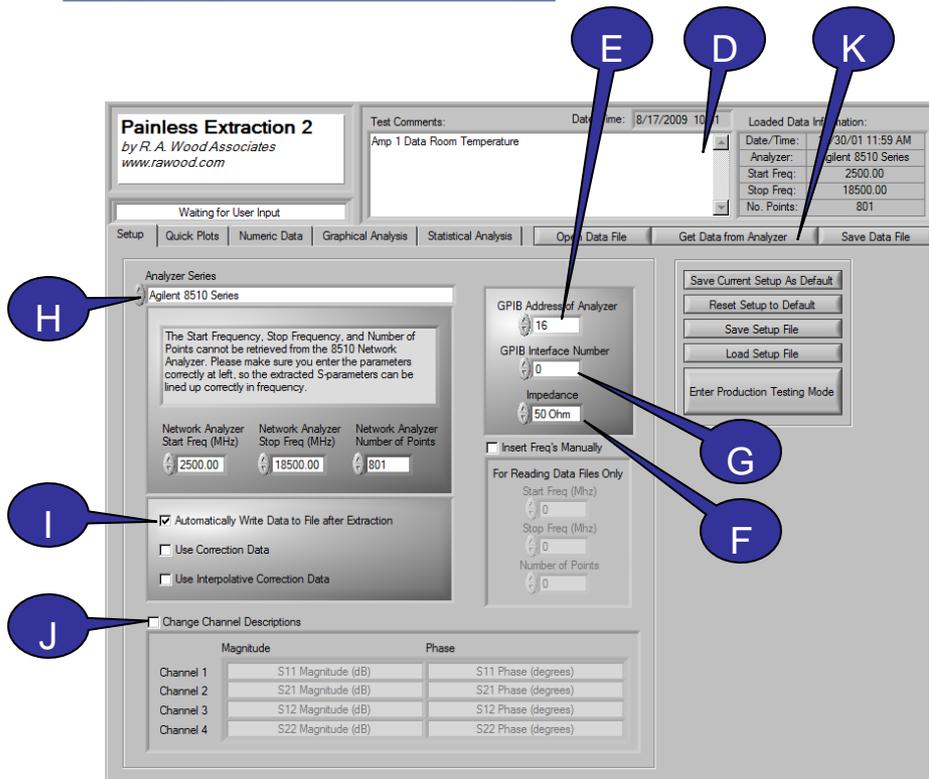
	Magnitude	Phase
Channel 1	S11 Magnitude (dB)	S11 Phase (degrees)
Channel 2	S21 Magnitude (dB)	S21 Phase (degrees)
Channel 3	S12 Magnitude (dB)	S12 Phase (degrees)
Channel 4	S22 Magnitude (dB)	S22 Phase (degrees)

The Setup Tab is primarily used at the start of the program. On this tab you will find all the parameters necessary to import an S2P file or to extract data from an analyzer.

To Import an S2P File:

- A.** **Test Comments** – Type a description or note for the test being performed. The S2P file will import previous test comments.
- B.** **Latest Extraction Information** – This indicator displays the setup parameters that were used to extract data.
- C.** Painless Extraction is capable of reading data files in the s2p format that were generated with other software. Some s2p files, however, do not contain the Start Frequency, Stop Frequency, and Number of Points at which data was extracted. To accurately read these files and perform statistical analysis, Painless Extraction requires manual entry of these parameters. To read such a file, select **Insert Freq's Manually**, and enter the parameters manually.
- D.** Enter **Start Frequency in MHz** that was used to run the test.
- E.** Enter the **Stop Frequency in MHz** that was used to run the test.
- F.** Enter the **Number of Network Analyzer Points** used for the test. This is not necessary for S2P files created with this program.
- G.** Go to File >> Open Data File... or click on **"Open Data File"** to load an existing data file to review test results.

Setup Tab – Extract Data



To Extract Data:

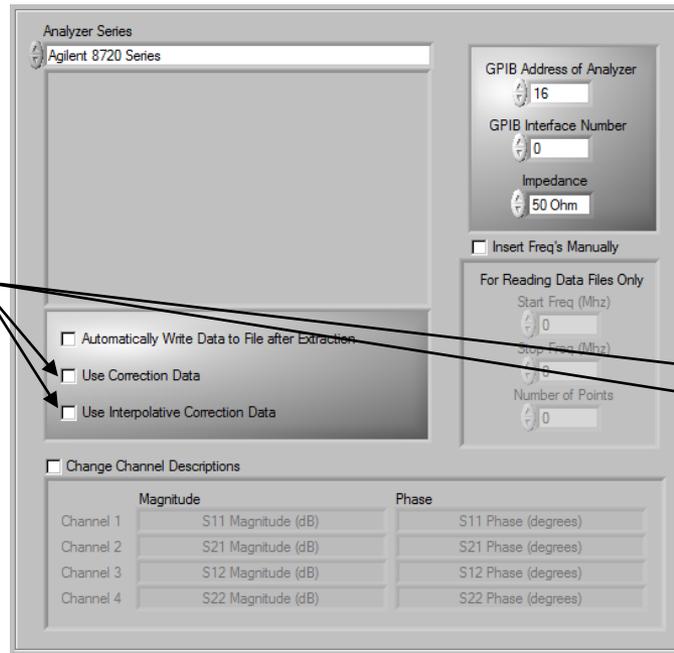
- A. Manually setup the Analyzer for the test.
- B. Connect the GPIB cable between the analyzer and the computer.
- C. On the *Setup Tab*, enter the appropriate parameters as follows:
- D. **Test Comments** – Type a description or notes for the test being performed.
- E. **GPIB Address of Analyzer** - Enter the General Purpose Interface Bus Address of the Network Analyzer.
- F. **Impedance** – Enter the reference resistance of the test data.
- G. **GPIB Interface Number** – Enter the GPIB Interface Number of the Network Analyzer
- H. **Analyzer Series** - Select the Analyzer Series to extract data from. This choice affects the available setup features. (See the next page for analyzer specific details).

- I. **Automatically Write Data to File After Extraction** - Select this option to automatically generate a prompt to save the data to a file after the extraction is complete. A dialog box will prompt you to browse for a location to save the data.
- J. **Change Channel Descriptions** – Select this option to overwrite the default channel names. These names will appear on all charts and graphs throughout the program.
- K. When all setup parameters are set as desired, click **Get Data from Analyzer** to automatically extract data from the selected Analyzer Series.

Setup Tab - Analyzer Specific Setup

Each analyzer series supported by this program utilizes a different method for extracting data. It is important to enter the correct setup parameters for the analyzer in use. Below is a listing of specific parameters for the individual analyzers (continued on the next page).

Agilent 8720 Series



Analyzer Series
Agilent 8720 Series

GPIB Address of Analyzer
16

GPIB Interface Number
0

Impedance
50 Ohm

Insert Freq's Manually

For Reading Data Files Only

Start Freq (Mhz)
0

Stop Freq (Mhz)
0

Number of Points
0

Automatically Write Data to File after Extraction

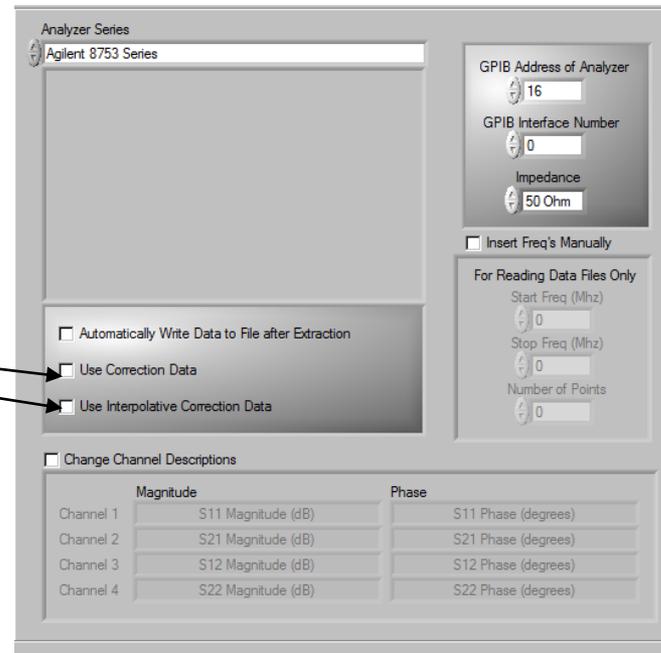
Use Correction Data

Use Interpolative Correction Data

Change Channel Descriptions

	Magnitude	Phase
Channel 1	S11 Magnitude (dB)	S11 Phase (degrees)
Channel 2	S21 Magnitude (dB)	S21 Phase (degrees)
Channel 3	S12 Magnitude (dB)	S12 Phase (degrees)
Channel 4	S22 Magnitude (dB)	S22 Phase (degrees)

Agilent 8753 Series



Analyzer Series
Agilent 8753 Series

GPIB Address of Analyzer
16

GPIB Interface Number
0

Impedance
50 Ohm

Insert Freq's Manually

For Reading Data Files Only

Start Freq (Mhz)
0

Stop Freq (Mhz)
0

Number of Points
0

Automatically Write Data to File after Extraction

Use Correction Data

Use Interpolative Correction Data

Change Channel Descriptions

	Magnitude	Phase
Channel 1	S11 Magnitude (dB)	S11 Phase (degrees)
Channel 2	S21 Magnitude (dB)	S21 Phase (degrees)
Channel 3	S12 Magnitude (dB)	S12 Phase (degrees)
Channel 4	S22 Magnitude (dB)	S22 Phase (degrees)

Check these boxes to extract the appropriate calibrated data.

Both the Agilent 8720 and the 8753 Analyzer Series automatically output all necessary parameters to accurately extract the data. Both of these analyzers have the option to *Use Correction Data* or *Use Interpolative Correction Data*. If these options are selected, the appropriate calibrated data will be extracted instead of the pure measured data.



Setup Tab – Analyzer Specific Setup Continued

Enter the No. of Network Analyzer points used for the test.

Enter the Stop Freq in MHz.

Enter the Start Freq in MHz.

Check these boxes to extract the appropriate calibrated data.

Agilent 8510 Series

Channel	Magnitude	Phase
Channel 1	S11 Magnitude (dB)	S11 Phase (degrees)
Channel 2	S21 Magnitude (dB)	S21 Phase (degrees)
Channel 3	S12 Magnitude (dB)	S12 Phase (degrees)
Channel 4	S22 Magnitude (dB)	S22 Phase (degrees)

Agilent 8757 c Scalar Analyzer

Channel	Magnitude	Phase
Channel 1	Channel 1: Off	Phase Data Not Available
Channel 2	Channel 2: Off	Phase Data Not Available
Channel 3	Channel 3: Off	Phase Data Not Available
Channel 4	Channel 4: Off	Phase Data Not Available

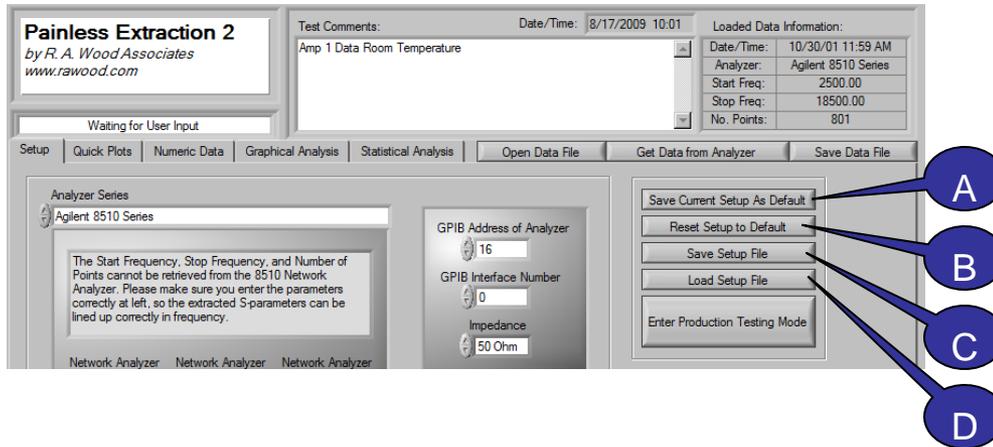
Agilent 8757e Scalar Analyzer

Channel	Magnitude	Phase
Channel 1	Channel 1: Off	Phase Data Not Available
Channel 2	Channel 2: Off	Phase Data Not Available
Channel 3	Channel 3: Off	Phase Data Not Available
Channel 4	Channel 4: Off	Phase Data Not Available

The *Start Frequency*, *Stop Frequency*, and *Number of Points* cannot be retrieved from the 8510 Network Analyzer. Please make sure you enter these parameters correctly, so the extracted S-parameters can be lined up properly with the frequency.

The *Start Frequency* and *Stop Frequency* cannot be retrieved from the 8757c/e Network Analyzers. Please make sure you enter these parameters correctly, so the extracted S-parameters can be lined up properly with frequency. These analyzers extract data exactly as it has been setup on the machine. Therefore, it is unnecessary to select *Use Correction Data*.

Settings Files



Painless Extraction utilizes a settings file to store the default test setup that is loaded at the start of program operation. This file is stored in an *.ini format. The following parameters are saved in the default setup file:

- **Setup Tab:** Analyzer Series, Network Analyzer Start Freq (MHz), Network Analyzer Stop Freq (MHz), Network Analyzer Number of Points, Automatically Write Data to File after Extraction, Use Correction Data, Use Interpolative Correction Data, Change Channel Descriptions, GPIB Address of Analyzer, GPIB Interface Number, Impedance
- **Graphical Analysis Tab:** Parameter, Analyze Freq Start (MHz), and Analyze Freq Stop (MHz)

The default settings may be overwritten to reflect the setup that you use most. Additional settings files may also be created to easily load alternate common setups.

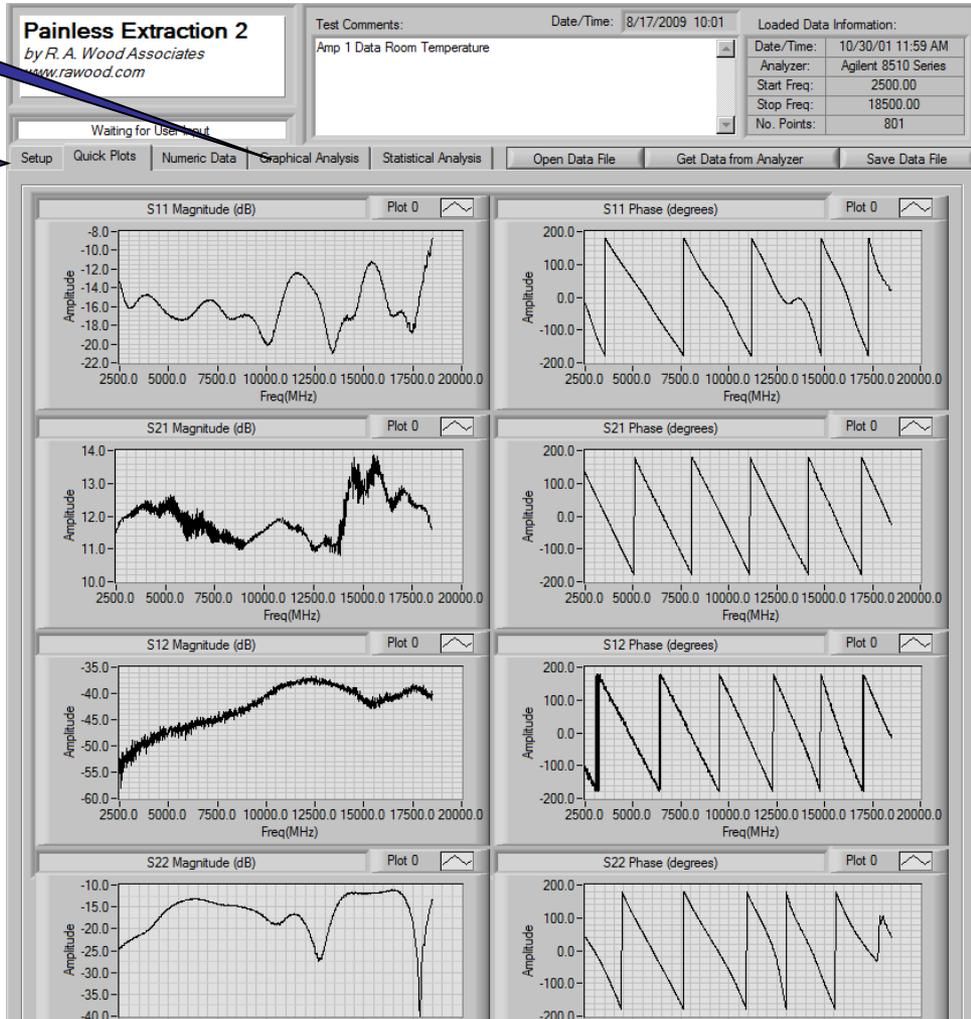
- A. Save Current Setup As Default** – Click here to save the current setup parameters as default. Default values will automatically load when Painless Extraction is opened, and whenever the *Reset Setup to Default* option is selected. Once the existing default values are overwritten, they may not be retrieved.
- B. Reset Setup to Default** – Click here to reset all setup parameters to their default values. Default values may be changed by selecting *Save Current Setup As Default*.
- C. Save Setup File** – Click here to save the current setup to a file for future recall. Multiple setup files may be saved to easily store commonly used setups. Settings files are by default saved in C:\Program Files\Painless Extraction. Saved setup files are also used in Painless Extraction Scriptor to define the setup parameters. Save the setup file here before entering Painless Extraction Scriptor.
- D. Load Setup File** – Click here to load an existing setup file. Setup files may be saved by selecting *Save Setup File*.



Quick Plots Tab

A

B



The *Quick Plots Tab* is the place to go to easily view magnitude and phase data across the entire frequency range for all extracted data channels.

- A. For more detailed and editable graphs, go to the *Graphical Analysis Tab*.
- B. To change the titles of these graphs, go to the *Setup Tab* and select *Change Channel Descriptions*. The user entered channel descriptions will become the titles for all graphs and charts throughout the program.
- C. Please note: The 8757c and the 8757c network analyzers do not have phase data. For these analyzers, the left column of graphs will be left blank.
- D. If an S2P File was loaded or saved, the file location will be displayed at the bottom of the tab.



Numeric Data Tab

The *Numeric Data Tab* may be used to view magnitude, phase, real, and imaginary data over the entire frequency range for all channels in two easy to read tables.

- A. Data is displayed to the millionths place.
- B. To change the **Titles** of each column, go to the *Setup Tab* and select *Change Channel Descriptions*. The user entered channel descriptions will become the titles for all graphs and charts throughout the program.
- C. Click here to **Export Data to Excel** from the db Magnitude and Phase Data table as well as the Imaginary and Real Data table. Excel will automatically open with the data in the new workbook on Sheet 1. The Imaginary and Real Data will be located one row beneath the db Magnitude and Phase Data. Once the data has been exported, all regular features of Excel are accessible.
- D. If an S2P File was loaded or saved, the **File Location** will be displayed at the bottom of the tab.

Painless Extraction 2
 by R. A. Wood Associates
 www.rawood.com

Test Comments: Amp 1 Data Room Temperature
 Date/Time: 8/17/2009 10:02

Loaded Data Information:
 Date/Time: 10/30/01 11:59 AM
 Analyzer: Agilent 8510 Series
 Start Freq: 2500.00
 Stop Freq: 18500.00
 No. Points: 801

Waiting for User Input

Setup
Quick Plots
Numeric Data
Graphical Analysis
Statistical Analysis
Open Data File
Get Data from Analyzer
Save Data File

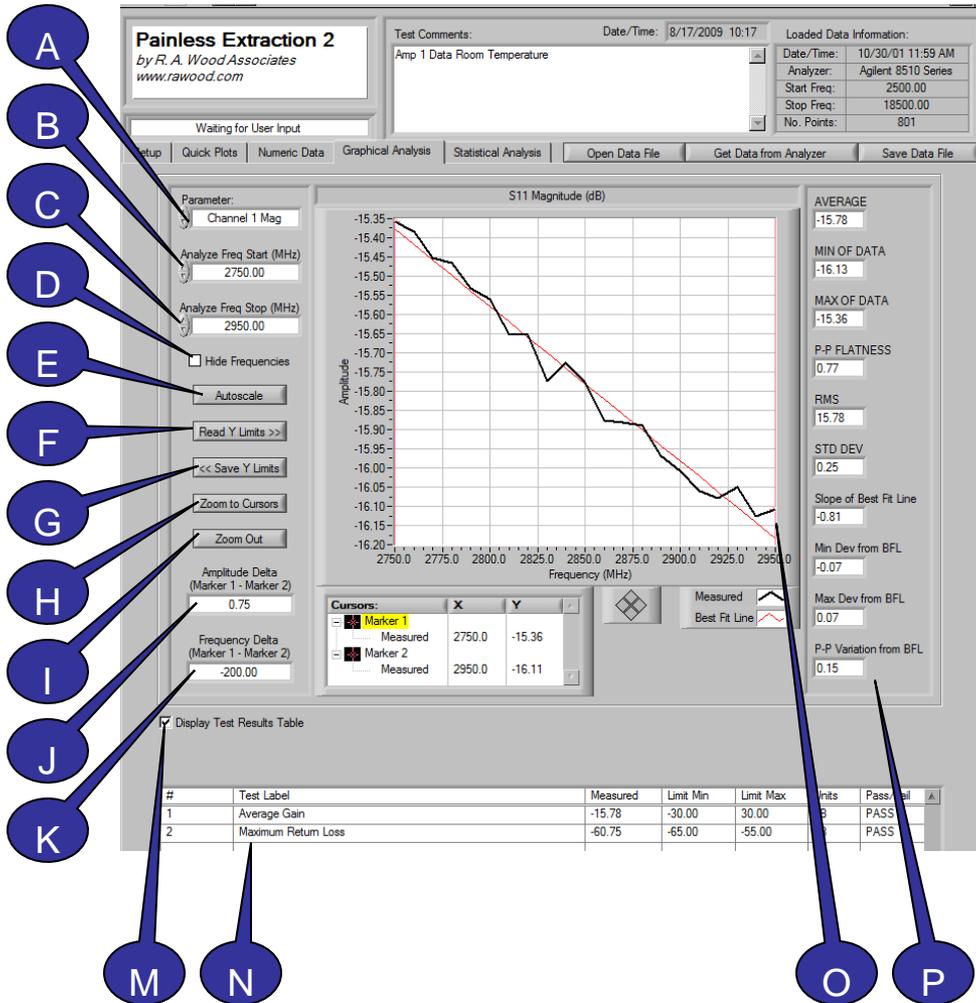
dB Magnitude and Phase Data								
Freq (Mhz)	S11 Magnitude (dB)	S11 Phase (degrees)	S21 Magnitude (dB)	S21 Phase (degrees)	S12 Magnitude (dB)	S12 Phase (degrees)	S22 Magnitude (dB)	S22 Phase (degrees)
2500.000000	-13.320591	-17.487411	11.492818	132.234596	-54.404606	-115.703930	-24.341049	40.460748
2510.000000	-13.398338	-18.766501	11.555907	130.998592	-53.436533	-115.096559	-24.527741	39.951732
2520.000000	-13.495511	-20.938823	11.576251	129.646844	-52.296343	-111.025650	-24.307891	38.555190
2530.000000	-13.612523	-22.700585	11.642034	128.165456	-58.022055	-101.390467	-24.246214	39.713232
2540.000000	-13.683935	-24.349013	11.635649	126.883823	-54.562049	-123.197249	-24.202195	38.765048
2550.000000	-13.761078	-26.208478	11.621982	125.252687	-52.671563	-127.924695	-24.275902	37.381529
2560.000000	-13.894284	-27.999697	11.643542	123.886029	-53.169095	-109.392265	-24.146472	36.403330
2570.000000	-13.932161	-29.747532	11.621075	122.783524	-54.824840	-119.772297	-24.277361	36.409935
2580.000000	-14.059904	-31.842188	11.596252	121.683102	-52.605400	-119.848018	-24.045226	33.957669
2590.000000	-14.079429	-33.301289	11.672340	120.481916	-55.489084	-111.864706	-24.224089	33.275789
2600.000000	-14.171664	-34.997875	11.715220	119.515878	-52.442238	-110.294794	-24.050514	33.466128
2610.000000	-14.247271	-36.706572	11.748008	118.246002	-56.451126	-123.204253	-24.172201	31.451915
2620.000000	-14.288392	-38.371258	11.782738	116.731005	-51.273178	-125.552310	-24.039122	30.782446

Imaginary and Real Data								
Freq (Mhz)	S11 Magnitude (dB) Real	S11 Magnitude (dB) Imag	S21 Magnitude (dB) Real	S21 Magnitude (dB) Imag	S12 Magnitude (dB) Real	S12 Magnitude (dB) Imag	S22 Magnitude (dB) Real	S22 Magnitude (dB) Imag
2500.000000	0.205788	-0.064835	-2.524170	2.780396	-0.000826	-0.001716	0.046158	0.039368
2510.000000	0.202469	-0.068794	-2.481567	2.854858	-0.000903	-0.001928	0.045517	0.038128
2520.000000	0.197494	-0.075569	-2.419189	2.919434	-0.000871	-0.002266	0.047623	0.037956
2530.000000	0.192467	-0.080513	-2.360718	3.003662	-0.000248	-0.001231	0.047180	0.039188
2540.000000	0.188515	-0.085312	-2.291260	3.053467	-0.001024	-0.001565	0.048065	0.038597
2550.000000	0.184006	-0.090576	-2.199951	3.112549	-0.001429	-0.001834	0.048569	0.037109
2560.000000	0.178329	-0.094818	-2.130371	3.171997	-0.000729	-0.002071	0.049934	0.036819
2570.000000	0.174591	-0.099777	-2.063599	3.204102	-0.000901	-0.001575	0.049183	0.036274
2580.000000	0.168411	-0.104591	-1.995972	3.233887	-0.001166	-0.002032	0.052063	0.035061
2590.000000	0.165245	-0.108551	-1.944702	3.303833	-0.000626	-0.001560	0.051407	0.033737
2600.000000	0.160248	-0.112198	-1.898071	3.352661	-0.000828	-0.002239	0.052330	0.034592





Graphical Analysis Tab



The *Graphical Analysis Tab* provides a large plot of the selected parameter and detailed statistical analysis.

- A. Click here to select the **Parameter** to display on the graph to the right. The following options are available: Frequency, Channel 1 Magnitude, Channel 1 Phase, Channel 2 Magnitude, Channel 2 Phase, Channel 3 Magnitude, Channel 3 Phase, Channel 4 Magnitude, and Channel 4 Phase
- B. **Analyze Start Frequency (MHz)** - Input the desired start frequency in MHz for the plot. This is the start frequency for the statistical calculations to the right. This value does NOT have to be the same as the *Start frequency* used to extract data.
- C. **Analyze Stop Frequency (MHz)** - Input the desired stop frequency in MHz for the plot. This is the stop frequency for the statistical calculations to the right. This value does NOT have to be the same as the *Stop frequency* used to extract data.
- D. **Hide Frequencies** - Select this option to hide the frequencies on the graph. This feature may be useful for printing and presenting proprietary data.
- E. **Autoscale** - Click here to automatically scale the graph to fit the data plot of the selected *Parameter*.



Graphical Analysis Tab - Continued

- F. Read Y Limits** - Click here to reset the Y Limits to the values saved with the << *Save Y Limits* button.
 - G. Save Y Limits** - Click here to save the current Y Limits for future recall. To reset the graph to these saved limits, select *Read Y Limits >>*.
 - H. Zoom to Cursors** – Click here to zoom in on the graph. The graph will zoom in on the section between the red marker lines. You may adjust the red marker lines by clicking and dragging them to a new location on the graph or by entering a value in the box marked marker 1 or marker 2 respectively.
 - I. Zoom Out** – Click here to zoom out on the graph.
 - J. Amplitude Delta** – Calculates and displays the difference between the amplitude of Marker 1 and Marker 2. Make sure that both marker lines are *Snapped To* the same line on the graph (Measured or Best Fit) to assure accuracy.
 - K. Frequency Delta** – Calculates and displays the difference between the frequency of Marker 1 and Marker 2. Make sure that both marker lines are *Snapped To* the same line on the graph (Measured or Best Fit) to assure accuracy.
 - L. Data File** – The path to the saved or loaded data file is displayed here. To load or save to a different location, select *Save Data File* or *Open Data File* respectively.
 - M. Display Test Results Table** – Select this option to display the *Test Results Table* from the *Statistical Analysis* tab on the *Graphical Analysis* tab. This may be useful for printing purposes.
 - N. Test Results Table** – This table displays the test results from the *Statistical Script File* on the *Statistical Analysis* tab. It contains the first seven columns from the script file table with the *Measured* data and the *Pass/Fail* analysis filled in. To hide this table on the *Graphical Analysis* tab, simply uncheck the box labeled *Display Test Results Table*.
 - O.** You may click and drag the **red marker lines** to any location on the graph or enter a numeric value for their location below. Then you may zoom to the selection between the marker lines by clicking on the *Zoom to Cursor* button.
 - P.** The **statistics** for the selected parameter are displayed to the right of the graph. For a detailed description of these quantities see the following page.
-



Graphical Analysis Tab Cont.

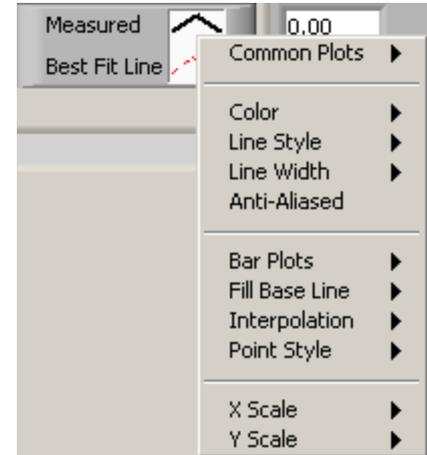
The following statistics are calculated and displayed on the *Graphical Analysis* tab based on the selected *Parameter* displayed on the graph between the *Analyze Freq Start (MHz)* and the *Analyze Freq Stop (MHz)*.

- **AVERAGE** - The value obtained by averaging the amplitude values between the *Analyze Start Freq* and the *Analyze Stop Freq*.
- **MIN OF DATA** - The Minimum amplitude value of the actual trace.
- **MAX OF DATA** - The Maximum amplitude value of the actual trace.
- **P-P FLATNESS** - The Peak to Peak Variation or the difference in amplitude between the *Min of Data* and the *Max of Data*
- **RMS** - The Root Mean Square value of the Data measured across the frequency band
- **STD DEV** - The Standard Deviation of the measured amplitude across the frequency band
- **Slope of Best Fit Line** - Measures the slope from the *Start frequency* to the *Stop frequency* of the Best Fit Line
- **Min Dev from BFL** - The value between *Min of Data* and the *Best Fit Line* at the *Min of Data* frequency point.
- **Max Dev from BFL** - The value between *Max of Data* and the *Best Fit Line* at the *Max of Data* frequency point.
- **P-P Variation from BFL** - The sum of the *Max Dev from BFL* and the *Min Dev from BFL* values.

AVERAGE	-10.89
MIN OF DATA	-20.39
MAX OF DATA	-1.23
P-P FLATNESS	19.16
RMS	12.24
STD DEV	5.58
Slope of Best Fit Line	19.24
Min Dev from BFL	-0.78
Max Dev from BFL	0.90
P-P Variation from BFL	1.68

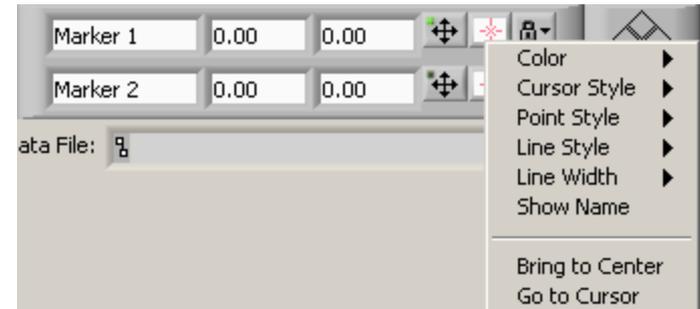
Line Display Options

- The color and style of the Measured and Best Fit line on the graph on the *Graphical Analysis Tab* may be customized. Left click on the Measured or Best Fit Line field to view an options menu.
- **Common Plots:** The *common plots* menu may be used to change the data display options. These options change the way in which the data points are connected and delineated. By default the standard line without individual data points is selected.
- **Color:** Select a custom color for the data line to make a bold presentation. By default the Measured line is black and the Best Fit line is red.
- **Line Style:** Use the *Line Style* menu to select between dashed and solid lines. By default the Measured line is solid and the Best Fit line is dashed.
- **Line width:** The *Line width* may be adjusted to accentuate the Data or Best fit line.
- **Point Size:** Use the *Point Size* menu to visually define the individual data points. Selecting any of the options in this menu will create bullets at each of the extracted frequencies on the graph
- **Other:** The remaining options (Anti-Aliased, Bar Plots, Fill Baseline, Interpolation, X Scale, and Y Scale) should be left on their default values. Although no harm will come in changing these options, they do not apply to the tests and presentation realm of PainlessExtraction.



Marker Line Properties

On the graph there are two green marker lines. These lines may be used to specify a region of focus on the graph. You may move these lines to any location by clicking and dragging them to a position or by entering a coordinate (Frequency, Amplitude) in the appropriate field. You may change the color and style of the marker lines by left clicking on the green star shaped button next to the desired marker line.



- **Visible Items:** This menu allows you to select which of the following elements are visible on the *Cursors* box.
- **Snap To:** Select which line the Marker Line will snap to from the following options: All Plots, Measured, or Best Fit Line
- **Attributes**
 - **Color:** Select a custom color for the marker lines to make them stand out or allow them to hide in the background.
 - **Cursor Style:** The cursor style option changes the look of the marker lines. You may choose between a single vertical line, cross hairs, or a single horizontal line.
 - **Point Style:** Use the *Point Size* menu to visually define the point at which the marker line crosses the data line.
 - **Line Style:** Use the *Line Style* menu to select between dashed and solid lines. By default the marker lines are solid.
 - **Line width:** The *Line width* may be adjusted to accentuate or deemphasize the marker lines.
 - **Show Name:** The *Show Name* option will display the name of the marker line on the graph.
 - **Allow Drag:** Enables you to point and click on the cursor lines to move them.
 - **Bring to Center:** *Bring to Center* moves the marker line to the center of the graph.
 - **Go to Cursor:** *Go to Cursor* shifts the graph to be centered around the current location of the marker line.
- **Create Cursor:** Adds another cursor line to the plot.
- **Delete Cursor:** Removes the selected cursor line from the plot.



Statistical Analysis Tab

The *Statistical Analysis Tab* may be used to open, create, and save statistical script files. A script file is used on this tab to perform pass/fail analysis of the data. Once the script file test has been run, a test results file may be saved.

- A. Statistical Script File** - Please view the following pages for detailed information on creating a script file.
- B. Run Print Script** - Click here to run the Print Script from the *Statistical Script File*. This will automatically read the *Statistical Script File* line by line. For each line in which the *Print* column contains a valid entry, the *Graphical Analysis* tab will be printed or sent to an image file. The *Graphical Analysis* tab will automatically be set up according to the entries in the *Parameter*, *Stat Start Freq*, *Stat Stop Freq*, and *Print* columns for the given row.
- C. Clear Table** - Click here to clear the *Statistical Script File* and the *Test Results* table. All cleared data will be lost.
- D.** To save a script file, go to **File >> Save Script File...** or click on **Save Script File**.

Painless Extraction 2
by R. A. Wood Associates
www.rawood.com

Test Comments: Amp 1 Data Room Temperature
Date/Time: 8/17/2009 10:17
Loaded Data Information:
Date/Time: 10/30/01 11:59 AM
Analyzer: Agilent 8510 Series
Start Freq: 2500.00
Stop Freq: 18500.00
No. Points: 801

Waiting for User Input

Setup Quick Plots Numeric Data Graphical Analysis **Statistical Analysis** Open Data File Get Data from Analyzer Save Data File

Load and/or edit statistical script files in the table below. The **Measured** data and **Pass/Fail** columns will be filled in automatically in the Test Results table. Only numeric entries in MHz are valid for the **Limit Min**, **Limit Max**, **Stat Start Freq**, and **Stat Stop Freq** columns. Use the following formats for the **Parameter**, **Stat**, and **Print** columns:

Parameter: ch# d
- channel number (1,2,3,4)
d - data type (m, p)
m - for magnitude data
p - for phase data
ex: ch1 m

Stat: enter only the characters in parentheses
Average (avg)
Min of data (min)
Max of data (max)
Standard Deviation (std)
P-P Flatness (p-p)
RMS (rms)
Slope of Best Fit Line (slope)
Min Deviation from BFL (min dev)
Max Deviation from BFL (max dev)
P-P Deviation from BFL (p-p dev)

Print Script: x1, x2, y1, y2, hide freq, show table, image out
x1 - x-axis start value
x2 - x-axis stop value
y1 - y-axis start value
y2 - y-axis stop value
hide freq - (T, F)
show table - (T, F)
image out - (i) to print to an image file. Leave blank to print to default printer. Leave this column blank to not print. Enter zeros for x1, x2, y1, and y2 to autoscale.
ex: 0, 2000, -10, 10, F, T, i

#	Test Label	Measured	Limit Min	Limit Max	Units	Pass/Fail	Parameter	Stat Start Freq	Stat Stop Freq	Stat	Print Script
1	Average Gain		-30	30	dB		ch1 m	2750	2950	avg	2750,2950,-16,-15
2	Maximum Return Loss		-65	-55	dB		ch1 p	2750	2950	max	2750,2950,-95,-60

Statistical Script File: %C:\Users\Amelia Steir\Desktop\ve-mail\PE Statistical Script.bt

#	Test Label	Measured	Limit Min	Limit Max	Units	Pass/Fail
1	Average Gain	-15.78	-30.00	30.00	dB	PASS
2	Maximum Return Loss	-60.75	-65.00	-55.00	dB	PASS

Test Results File: % Data File: % data.bt

Copyright ©1998 - 2008 by R. A. Wood Associates www.rawood.com

F

I

G

H

B

C

A

D

E



Statistical Analysis Tab Continued

- E. To open a script file, go to **File >> Open Script File...** or click on **Open Script File**.

 - F. **Statistical Script File** - This field displays the path to the location that the *Statistical Script File* has been saved to or loaded from.

 - G. **Test Results** - This table displays the test results from the *Statistical Script File*. It contains the first seven columns from the table above with the *Measured* data and the *Pass/Fail* determination filled in.

 - H. To save a test results file, go to **File >> Save Test Results File...** or click on **Save Test Results**.

 - I. **Test Results File** - This field displays the path to the location that the *Test Results* file has been saved.

 - J. **Data File** - If an S2P File was loaded or saved, the file location will be displayed at the bottom of the tab.
-



Script File Cont.

- **#** - Reference Number of the Test. This is not a required field.
- **Test Label** - Description of the Test. Use descriptive labels to help troubleshooting results after the tests. This is not a required field.
- **Measured** - Value measured by the test. This will be blank in the script file. It will be filled in on the *Test Results* table.
- **Limit Min** - Minimum value to be compared with the *Measured* value. Only a numeric entry is valid. Use the units column or *Test Label* for a description.
- **Limit Max** - Maximum value to be compared with the *Measured* value. Only a numeric entry is valid. Use the units column or *Test Label* for a description.
- **Units** - Units that the test will be measured in.
- **Pass/Fail** - Determined by checking whether the *Measured* value falls between the Limit Min and Limit Max. This will be left blank on the *Statistical Script File* and automatically filled in on the *Test Results* table.
- **Parameter** - This is the channel and type of data that will be analyzed. Please note that the 8757c and the 8757e do not have phase data. Parameter Options (Only the characters in parentheses are valid entries):
 - Channel 1 Magnitude (ch1 m)
 - Channel 1 Phase (ch1 p)
 - Channel 2 Magnitude (ch2 m)
 - Channel 2 Phase (ch2 p)
 - Channel 3 Magnitude (ch3 m)
 - Channel 3 Phase (ch3 p)
 - Channel 4 Magnitude (ch4 m)
 - Channel 4 Phase (ch4 p)



Script File Cont.

- **Stat Start Freq** - Starting frequency of the measurement from which statistics are obtained. Only a numeric entry in MHz is valid.
- **Stat Stop Freq** - Ending frequency of the measurement from which statistics are obtained. Only a numeric entry in MHz is valid.
- **Stat** - This data field represents which statistic will be determined from the selected *Parameter*, within the limits of *Stat Start Freq* and *Stat Stop Freq*. Statistic Type Options (Only the characters in parentheses are valid entries):
 - Average (avg)
 - Min of Data (min)
 - Max of Data (max)
 - P-P Flatness (p-p)
 - RMS (rms)
 - Standard Deviation (std)
 - Slope of Best Fit Line (slope)
 - Min Deviation from BFL (min dev)
 - Max Deviation from BFL (max dev)
 - P-P Variation from BFL (p-p dev)
- **Print** - This column is used to specify printing parameters to quickly and easily print the *Graphical Analysis* tab data for the given row. The specifications for each row will be printed after the *Run Print Script* button has been selected. To not print a given row, leave the *Print* column blank. The format for the print column parameters must be entered as follows:
x1, x2, y1, y2, hide frequency, show table, image file
 - **x1** - Analyze Freq Start(MHz) - The start frequency for scale on the graph.
 - **x2** - Analyze Freq Stop (MHz) - The stop frequency for the scale on the graph.
 - **y1** - Amplitude Start - The minimum y-value for the scale on the graph.
 - **y2** - Amplitude Stop - The maximum y-value for the scale on the graph.
 - **hide frequency** - (T or F) - Enter T or F to hide or show the frequencies on the graph respectively.
 - **show table** - (T or F) - Enter T or F to show or hide the Test Results table on the graph.
 - **image file** - (i) - Enter i to print to an image file. Leave blank to print to the default printer. The image file will automatically be saved in the same directory as the Statistical Script File.Enter zeros for x1, x2, y1, and y2 to autoscale the plot for print.



Test Results File

Below is a sample Test Results File that was created in Painless Extraction and opened in Excel. This file may also be opened in Notepad, or WordPad. The top of the file contains the test date/time, text comments, and the analyzer setup information. After this header information, the test results table is displayed.

- This table contains the test results from the script file. It has the first seven columns from the script file table with the *Measured* data filled in and the Pass/Fail determination filled in.
- You may save the test results to a file by clicking on the *Save Test Results* button on the *Statistical Analysis Tab* or by going to *File >> Save Test Results File...*

Microsoft Excel - Test Results File

File Edit View Insert Format Tools Data Window Help Adobe PDF

Type a question for help

100% Arial 10 B I U

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	! 11/28/2006 10:01 PM																
2	! Midwest RAW 2-11 SN 003																
3	! Freq (MHz)! S21 Magnitude (dB)! Phase Data Not Available! S11 Magnitude (dB)! Phase Data Not Available! S12 Magnitude (db)! Phase Data Not Available																
4	! Agilent 8757c/e Scalar Analyzer! Start Freq: 500.00! Stop Freq: 18000.00! Number of Points: 401																
5																	
6	Test No	Test Label	Measured	Limit MIN	Limit MAX	Units	Pass/Fail										
7	1	Slope	11.81	10	12	dB	PASS										
8	2	P-P Flatness about BFL	1.4	0	3	dB P-P	PASS										
9	3	min gain at high end of band	-1.4	-3	0	dB	PASS										
10	4	Max Return Loss	-14.08	-99	-12	dB	PASS										



S2P File

Below is a sample S2P file that was saved using Painless Extraction and opened in Notepad. These files are in standard S2P format and may be opened using Notepad, WordPad, or Excel. The top of the file contains the header information which includes the test date/time, test comments, and the setup parameters for the analyzer used. The rest of the file is tab separated data.

Microsoft Excel - Amp1 Data.s2p

File Edit View Insert Format Tools Data Window Help

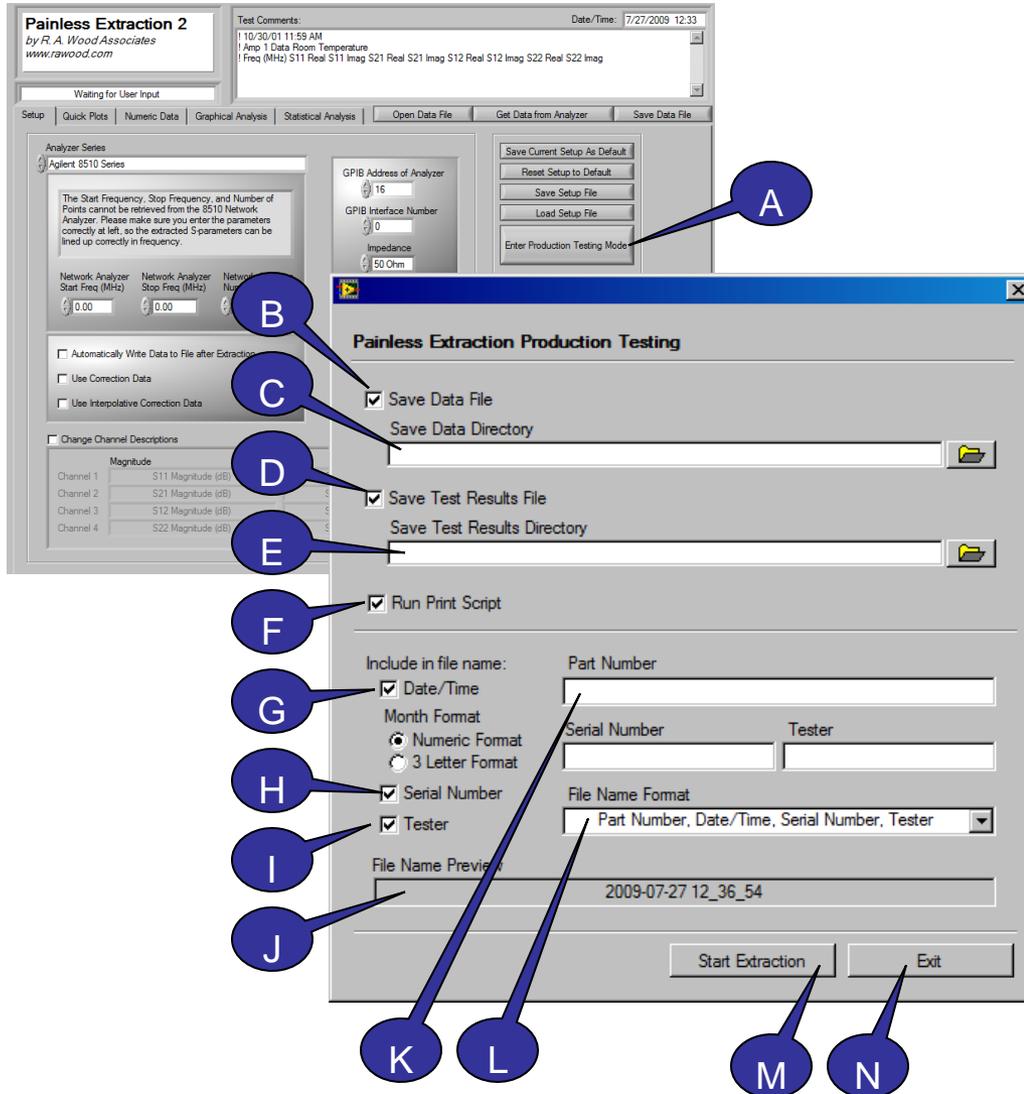
Go to Office Live Open Save

	A	B	C	D	E	F	G	H	I
1	! 10/30/01 11:59	AM							
2	! Amp 1 Data Room	Temperature							
3	! Freq (MHz)! S11	Real S11 Imag S21	Real S21 Imag S12	Real S12 Imag S	22 Real S22 Imag				
4									
5	! Freq (MHz)! S11	Magnitude (dB)! S11 Phase (degrees)	! S21 Magnitude (dB)! S21 Phase (degrees)! S12 Ma	gnitude (dB)! S12	Phase (degrees)! S22 Magnitude (dB)				
6	! Agilent 8510 Se	ries! Start Freq:	0.000000! Stop Fre	q: 0.000000! Nu	mber of Points: 2	0! Automatically	Write Data to Fil	e After Extractio	n: F! Use Correctio
7	# MHz S DB R 50								
8	2500	-13.32059061	-17.48741102	11.49281822	132.2345962	-54.40460587	-115.70393	-24.34104932	40.4607481
9	2510	-13.3983384	-18.76650095	11.55590738	130.9985917	-53.43653276	-115.096559	-24.52774147	39.95173159
10	2520	-13.49551099	-20.93882347	11.57625083	129.6468443	-52.29634302	-111.0256496	-24.30789062	38.55519048
11	2530	-13.61252347	-22.70058522	11.64203352	128.1654563	-58.02205486	-101.3904669	-24.24621414	39.71323193

Production Testing Mode

The Production Testing Mode enables the user to quickly test multiple components and save the results to a file in an automated fashion.

Before entering the *Production Testing Mode*, setup the *Analyzer Series* parameters on the *Setup* tab, and the *Statistical Script File* on the *Statistical Analysis* tab.



The screenshot shows the 'Painless Extraction 2' software interface. The 'Painless Extraction Production Testing' dialog box is open, with various settings and callouts:

- A:** 'Enter Production Testing Mode' button.
- B:** 'Save Data File' checkbox.
- C:** 'Save Data Directory' field.
- D:** 'Save Test Results File' checkbox.
- E:** 'Save Test Results Directory' field.
- F:** 'Run Print Script' checkbox.
- G:** 'Include in file name:' section, specifically the 'Date/Time' checkbox.
- H:** 'Month Format' section, specifically the 'Numeric Format' radio button.
- I:** 'Serial Number' checkbox.
- J:** 'Tester' checkbox.
- K:** 'Part Number' field.
- L:** 'Serial Number' field.
- M:** 'Tester' field.
- N:** 'File Name Preview' field.

- A.** Click here to enter the **Production Testing Mode**. A dialog box will open in which the user can setup the production testing settings.
- B.** **Save Data File** - Select this option to automatically save the data to a file after the extraction is complete. The data file will be saved in the *Save Data Directory* under the name displayed in the *File Name Preview* below.
- C.** **Save Data Directory** - This field displays the path to the directory in which the data file will be saved after the extraction is complete. To select a new directory, click the file folder to the right, and browse for the desired save location. Once you have located the desired directory, click the *Current Directory* button.

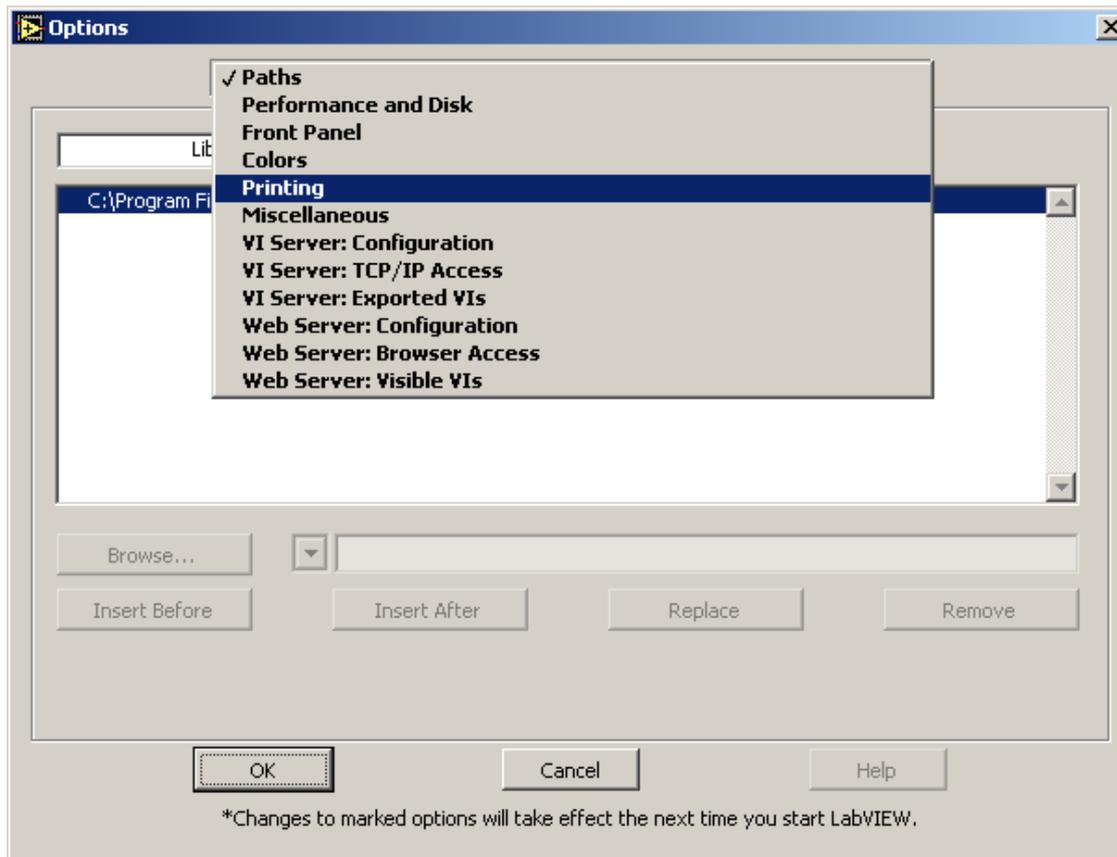


Production Testing Mode - Continued

- D. Save Test Results** - Select this option to automatically generate and save a test results file after the extraction is complete. The test results file is generated using the statistical script file that is open on the *Statistical Analysis* tab of Painless Extraction. The script file must be opened in Painless Extraction before the Production Testing may begin. The test results file will be saved in the *Save Test Results Directory* under the name displayed in the *File Name Preview*.
 - E. Save Test Results Directory** - This field displays the path to the directory in which the test results file will be saved after the extraction is complete. To select a new directory, click the file folder to the right, and browse for the desired save location. Once you have located the desired directory, click the *Current Directory* button.
 - F. Run Print Script** – Check this box to run the print script from the *Statistical Script File* as part of the *Production Testing*. If this box is left unchecked, the *Statistical Script File* will still run, but the *Print Script* column will be ignored.
 - G. Date/Time** - Select this option to included the current date and time in the file name for the *Data File* and the *Test Results*. Select between *Numeric Format* and *3 Letter Format* for the format of the date and time.
 - H. Serial Number** - Select this option to include the *Serial Number* in the name of the *Data File* and the *Test Results File*. Enter the *Serial Number* in the field to the right.
 - I. Tester** - Select this option to include the Tester's name or initials in the name of the *Data File* and the *Test Results File*. Enter the Tester's name or initials in the field to the right.
 - J. File Name Preview** - This field displays the naming scheme for the *Data File* and the *Test Results File*.
 - K. Part Number** - Enter the Part Number here to include it in the file name of the *Data File* and the *Test Results File*.
 - L. File Name Format** - Select the desired file name format from the drop-down menu. See the *File Name Preview* to view the selected format.
 - M. Start Extraction** – Click here to extract data from the Analyzer Series and perform the production testing.
 - N. Exit** – Click here to exit the Production Testing Mode and return to Painless Extraction.
-

Printing

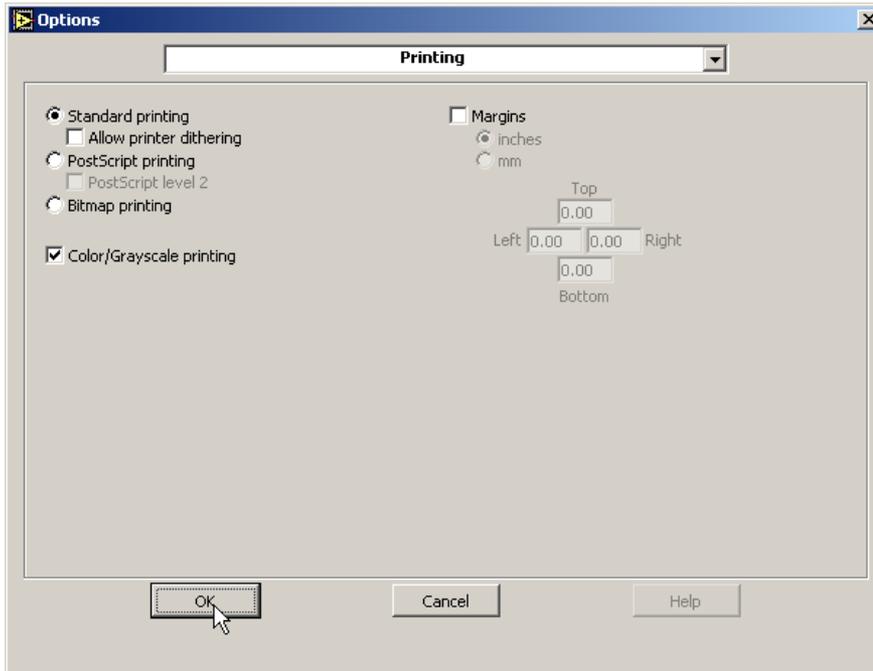
- The default printer is set for a postscript type printer.
- To print on an ink jet printer go to **Tools>>Options**. In the pop up window, click on the arrow next to Paths and select **Printing**.



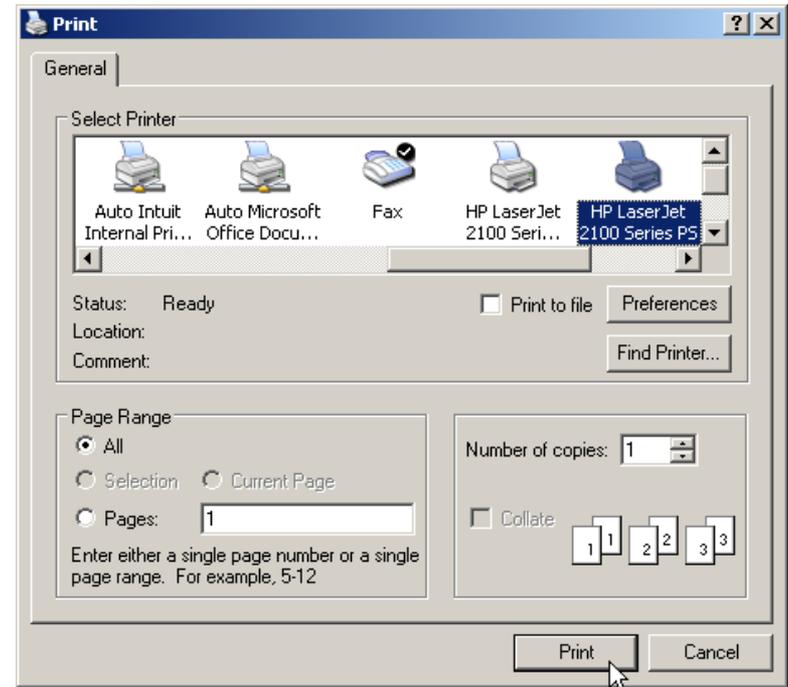


Printing Cont.

- Set the printing options to **Standard Printing** and click **OK**.



- On the panel that you want to print, go to **File>>Print Window....** In the dialog box select the ink jet printer and click **Print**

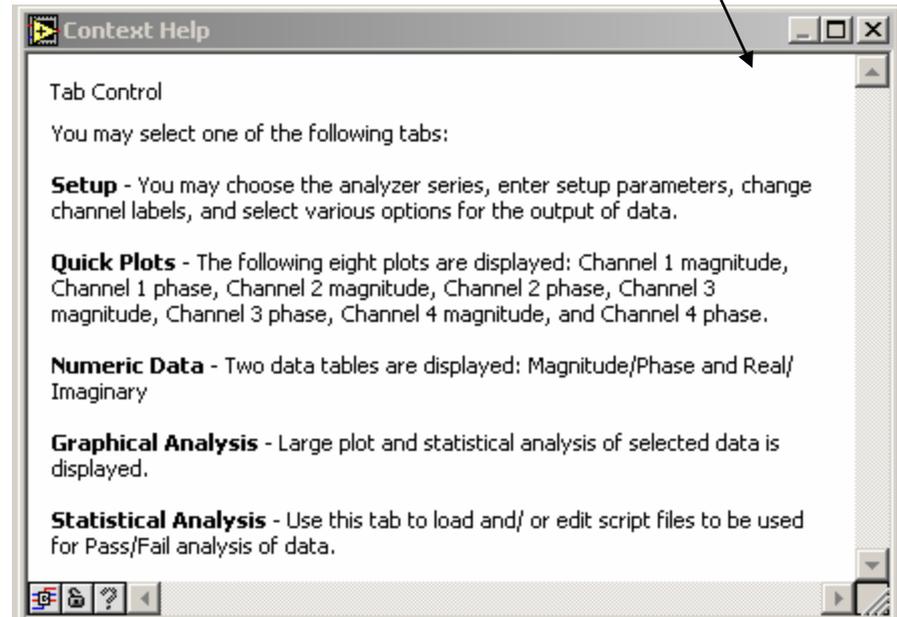


Help Menu

- For help on functions while Painless Extraction is running, go to Help >> Show Context Help. This will bring up a window with helpful tips that change according to the location of your mouse. Drag your mouse over buttons, graphs, or tables to view detailed descriptions of their functions (see example below).
- For additional Help resources please visit our Software Support Forum at: <http://helprawoodsoftware.rawood.com/tiki-index.php>
- As always, if you run into problems, don't hesitate contact us any time at 315-735-4217 or rawood@rawood.com

This is an example Context Help Window that is displayed when the mouse button hovers over the Setup Tab. Move the mouse to hover over different buttons, graphs, or tables to view help on other functions.

Click on Show Context Help to bring up Help window.





Purchasing Information

- We currently offer several methods for purchasing our software products:
 - Select the desired method from within the program itself (recommended for single purchases)
 - Use the PayPal Forms on our software download page : http://rawood.com/software_products/purchase_software.html (useful for purchasing multiple programs)
 - Fill out the WWW form
 - Contact us directly so we can contact you for payment arrangements
- When purchasing, please double check that both your User Name and Registration Key are correct.

