Keysight Technologies

U8903A Audio Analyzer

Creating a Custom Filter for the U8903A Audio Analyzer

Demo Guide

KEYSIGHT TECHNOLOGIES

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Demonstration objectives

This demonstration will teach you how to create your own custom filter for the Keysight Technologies, Inc. U8903A Audio Analyzer by using the MATLAB software on your computer.

Steps to create a custom filter

Follow the steps below to create your own custom filter for the U8903A.

Steps	
1.	Matlab fdatool (filter design and analysis tool)
2.	Create Filter
3.	Export Filter Coefficient
4.	Settling Time (Delay)
5.	Transfer to .juf file
6.	Upload .juf file to U8903A Audio Analyzer

Step 1

Matlab fdatool (Filter Design and Analysis Tool)

Instructions
1. Start MATLAB program (Figure 1)
2. In the command window, type “fdatool” to start Filter Design and Analysis Tool in MATLAB (Figure 2)

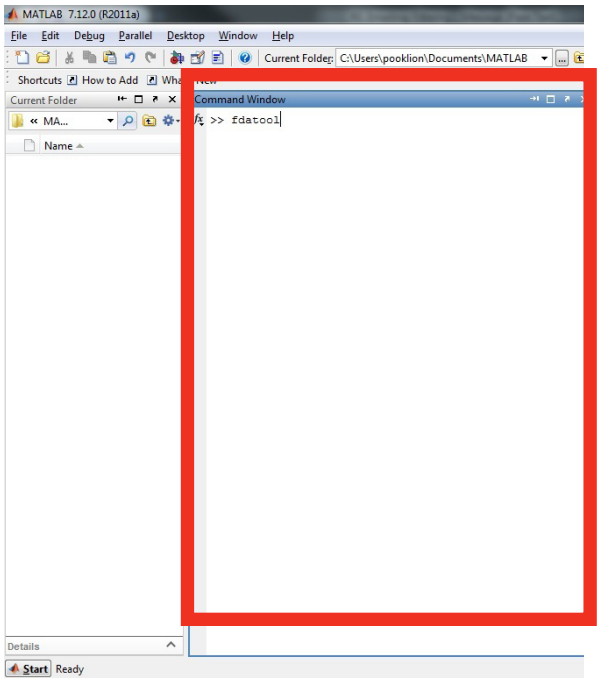


Figure 1. MATLAB command window

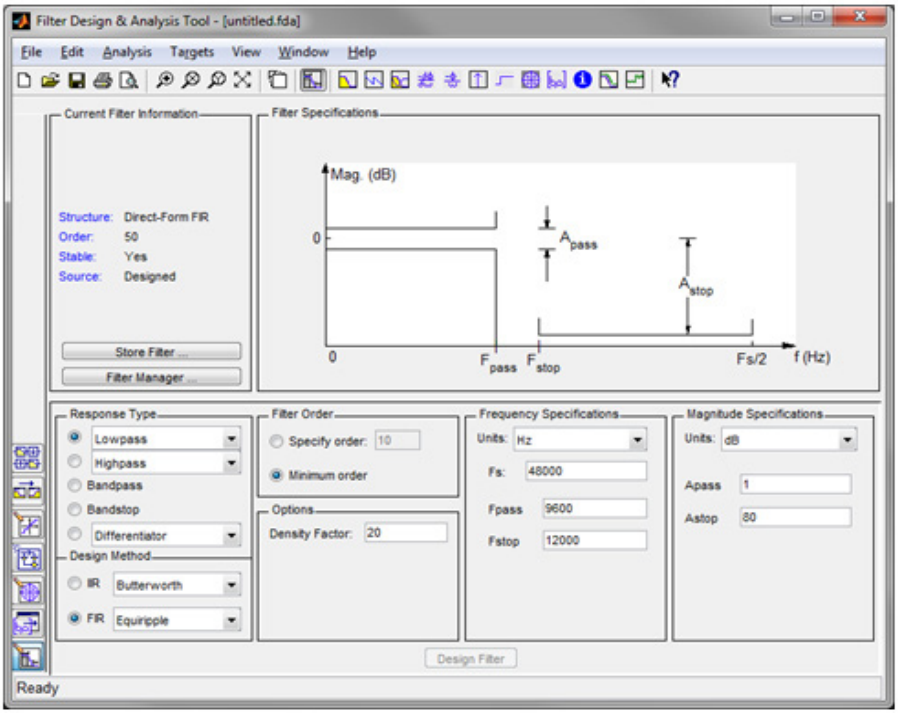


Figure 2. Filter Design and Analysis Tool

Step 2

Create filter

Instructions	
1.	Click on “Set quantization parameter” (Figure 3)
2.	Select “Single-precision floating-point” because the architecture of the U8903A is 32 bits (Figure 4)
3.	Return to the Design Filter page (Figure 4)

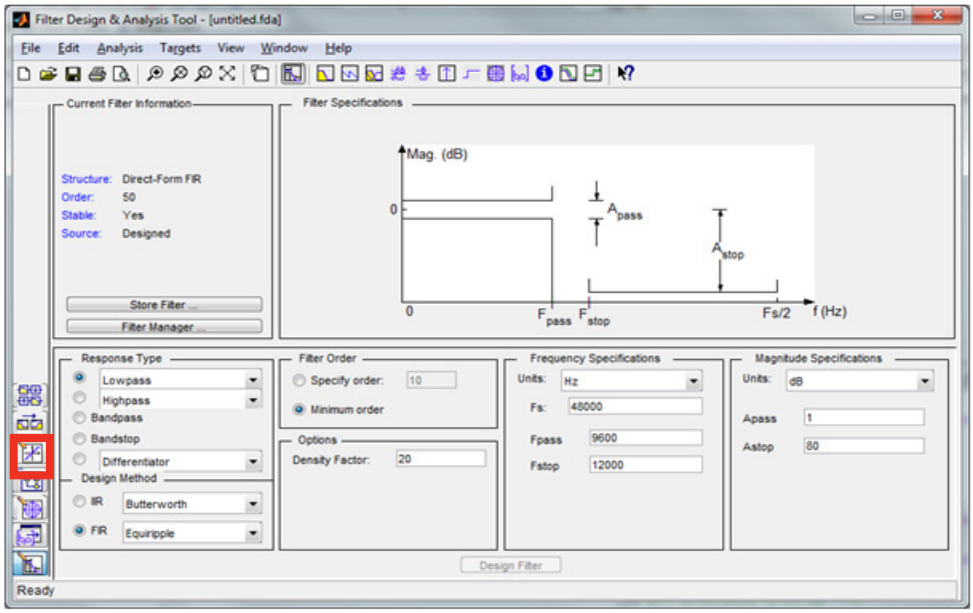


Figure 3. “Set quantization parameter” icon

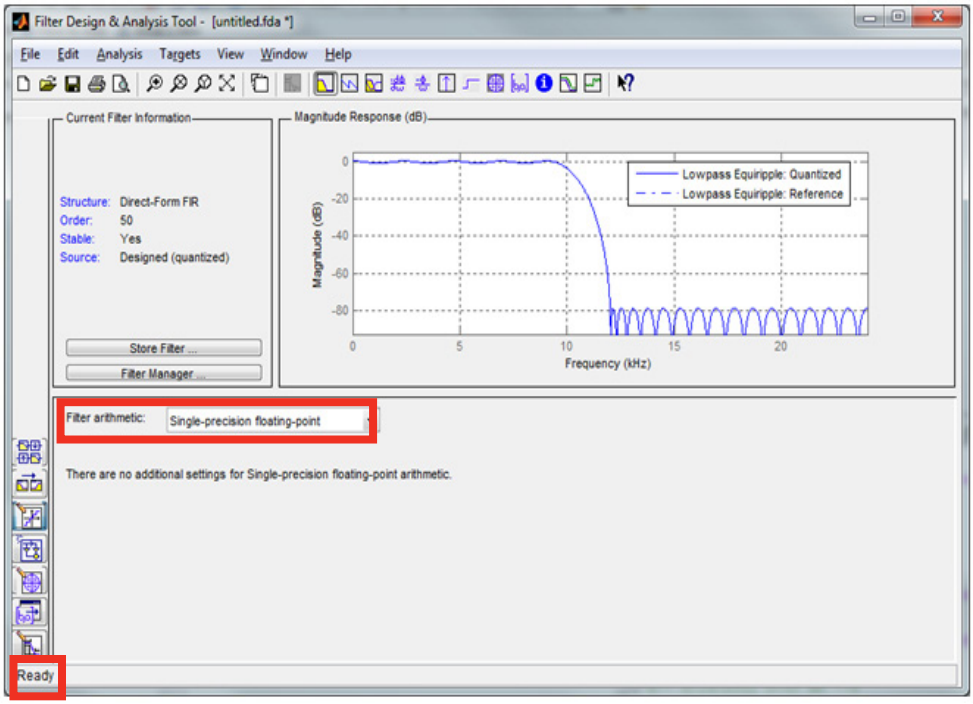


Figure 4. Selecting “Single-precision floating-point” and “Return to the Design Filter page”

Instructions
4. Select the “Response Type” e.g. Lowpass, Highpass, Bandpass, and Bandstop (Figure 5)
5. Select the “Design Method” e.g. IIR or FIR (Figure 5)
6. Select the “Frequency Specifications” you require e.g. Fpass (1 and 2), Fstop (1 and 2) (Figure 5)

Requirements for Frequency Specifications:

- Low Bandwidth = 78125 Hz
- High Bandwidth = 312500 Hz

7. Select the “Magnitude Specifications” e.g. Wpass (1 and 2), Wstop (1 and 2) (Figure 5)
8. Press the “Design Filter” button (Figure 5)

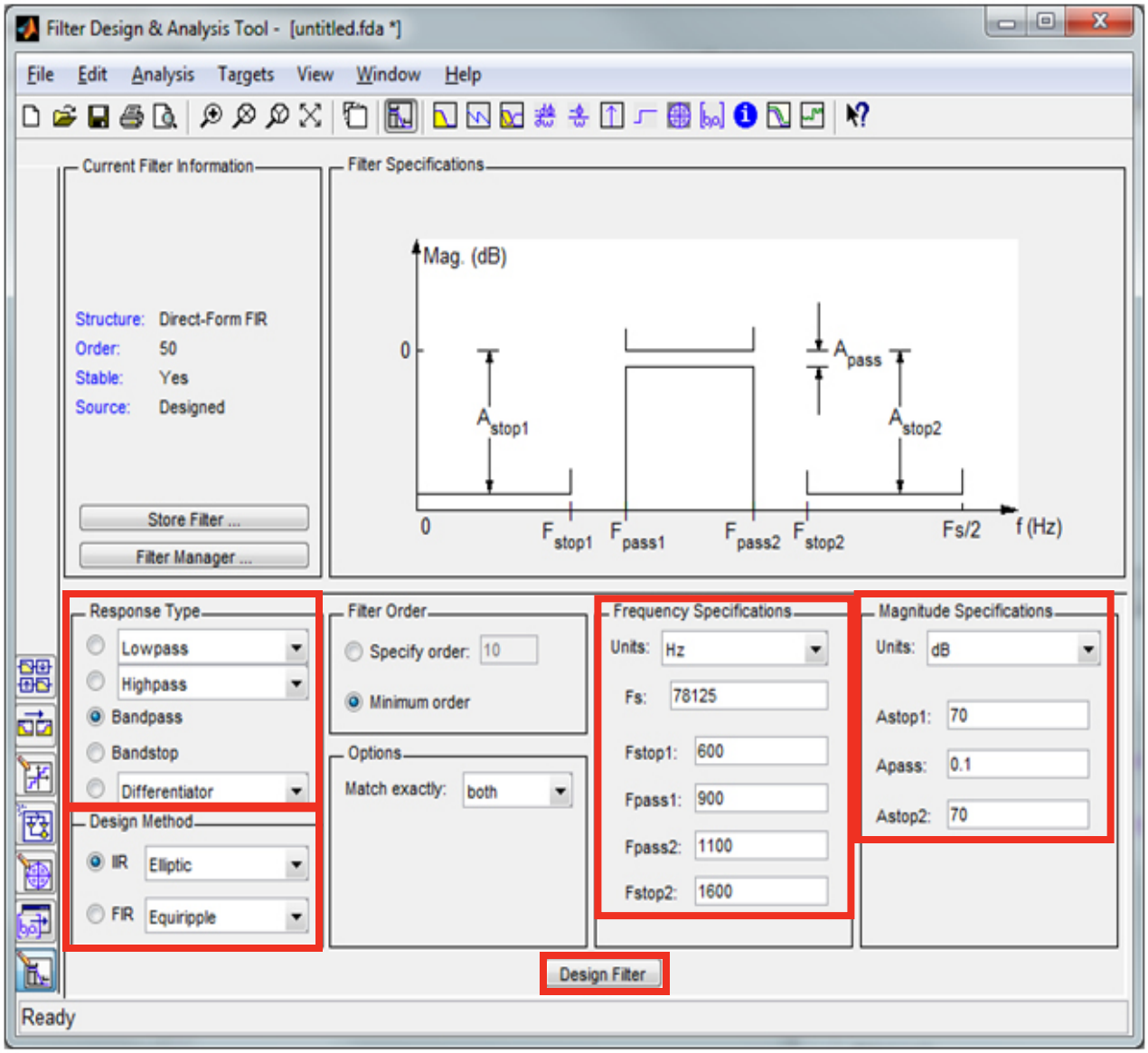


Figure 5. Selecting “Response Type”, “Design Method”, “Frequency Specifications”, “Magnitude Specification”, and Press “Design Filter” Button

Instructions

9. The “Order” number (see Figure 6) must be less than 256 in order to meet the architecture of the U8903A Audio Analyzer. Changing the “Design Method” will change the order number.

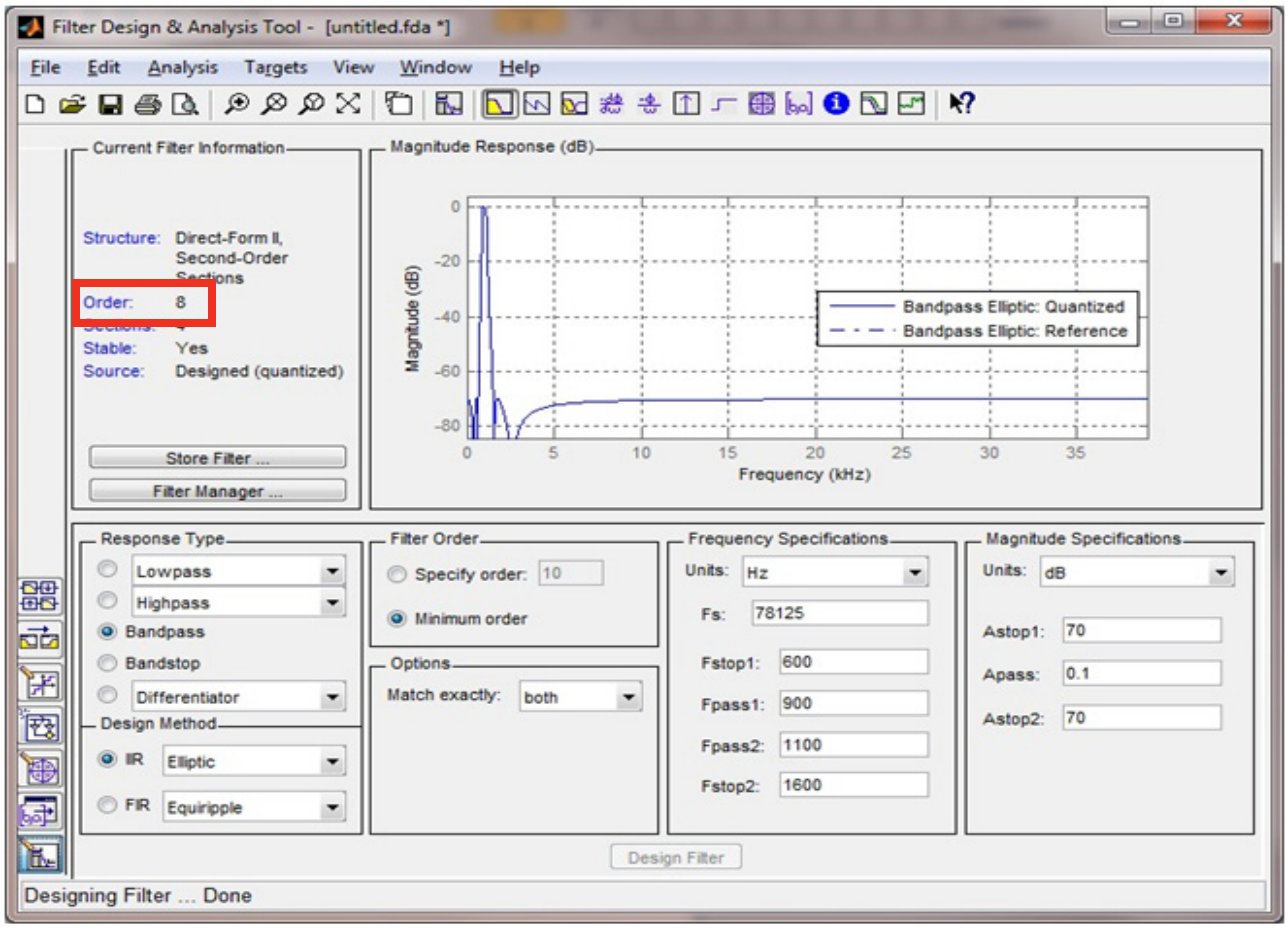


Figure 6. Order number must be less than 256

Step 3

Export filter coefficient

Export filter coefficient information to a file (figure 7)

Instructions
1. Go to “File”, then select “Export...”
2. At “Export To”, select “Coefficient File (ASCII)”
3. Click on “Export” button, and Save to *.fcf file
4. The Filter Coefficient Data File will then be displayed

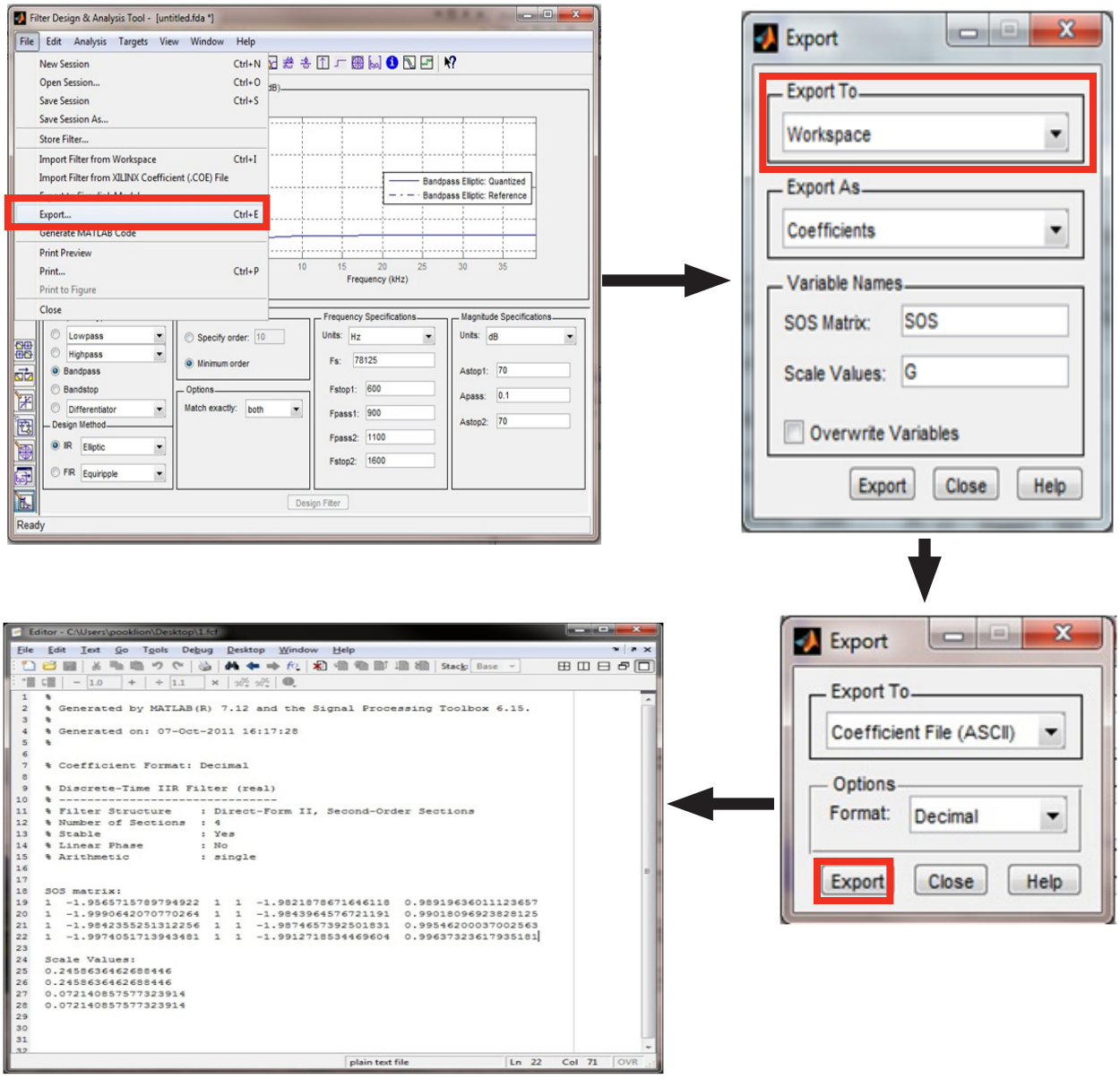


Figure 7. Exporting Filter Coefficient Information to a file

Export filter coefficient as an object for analysis (Figure 8)

Instructions
1. Go to “File”, then select “Export...”
2. At “Export To”, select “Workspace”
3. At “Export As”, select “Object”
4. At “Variable Names”, for “Discrete Filter”, enter “Hd”, then click the “Export” button
5. The Hd object is then in the MATLAB window

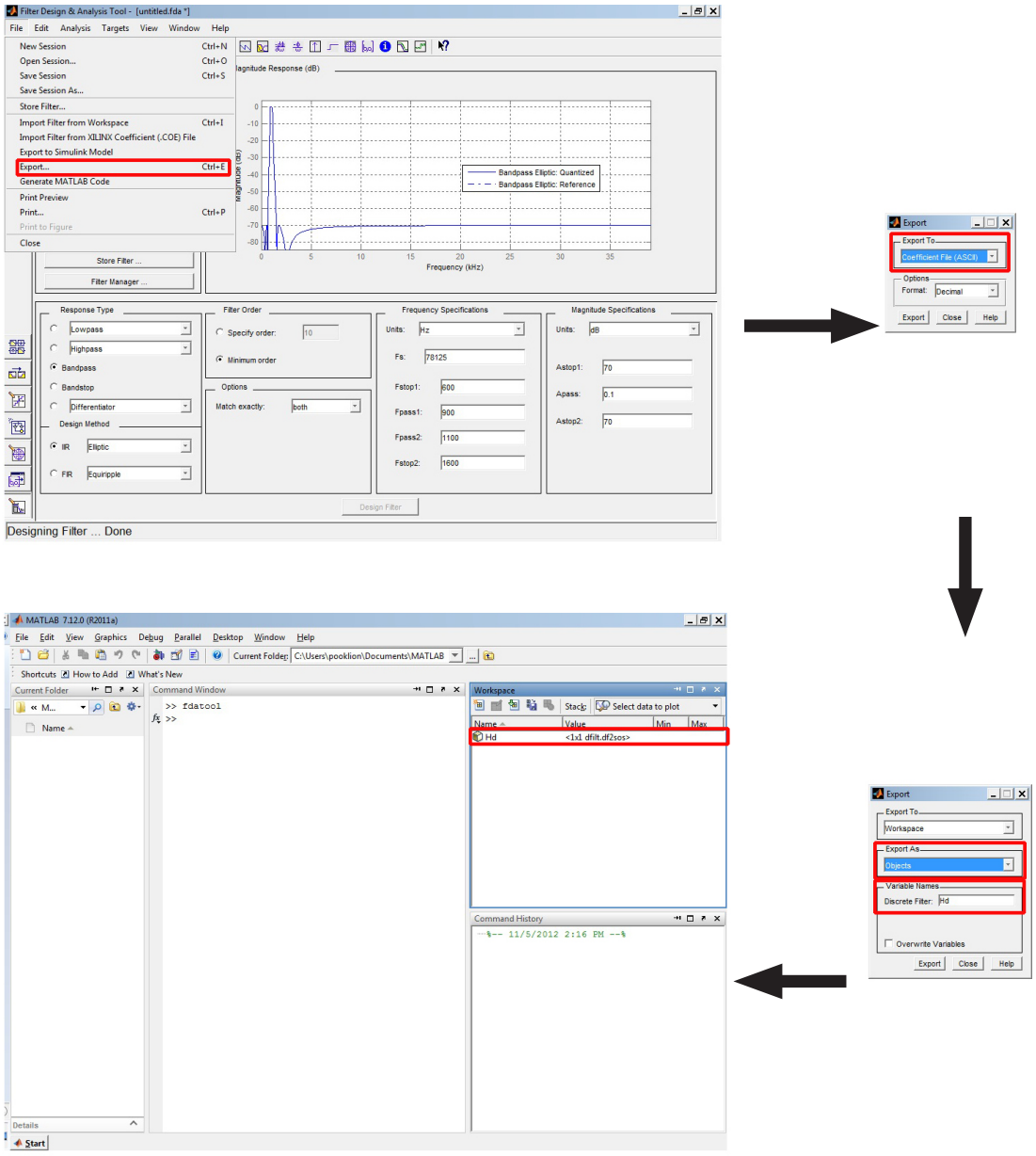


Figure 8. Export Filter Coefficient as an object for analysis

Step 4

Settling time (Delay)

Knowing the settling time of your filter

You can know the settling time for your filter by creating a 20 Hz Sine Wave for testing the filter you just created using the MATLAB software

Instructions
In the MATLAB command window

1. Type in the code below:
   - fs = 78125
   - f = 20
   - n = 1:65536
   - xn = sin(2*pi*f*n/fs)

These objects (fs, f, n, and xn) are now created in Matlab (Figure 9):
- fs (Frequency Sampling): 78125 for low bandwidth 312500 for high bandwidth
- f(Frequency): 20 Hz
- n(Points): 1 to 65536
- xn (20 Hz Sine wave)

2. Type in the code below to plot the 20 Hz sine wave:
   - plot(xn,'DisplayName','xn','YDataSource','xn');figure(gcf);

A 20 Hz Sine wave graph (Figure 10) is created.

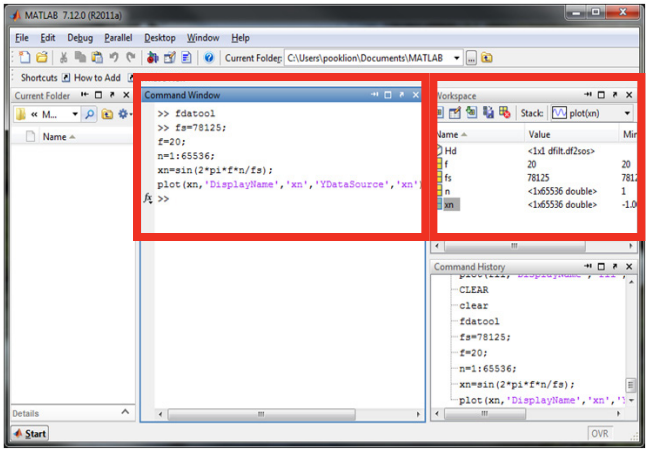


Figure 9. MATLAB command window and objects

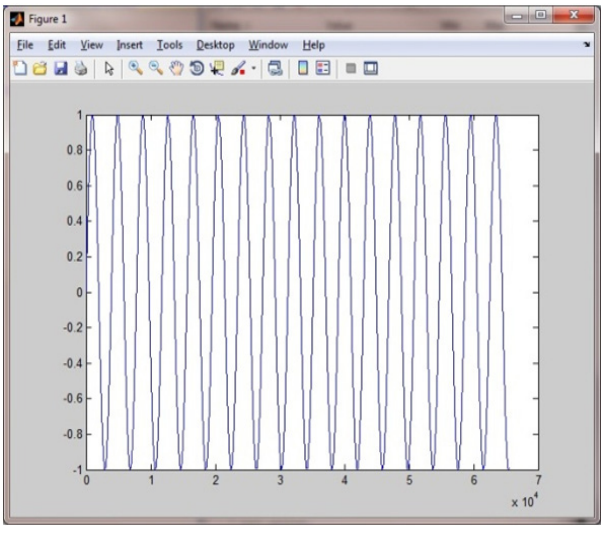


Figure 10. 20 Hz Sine wave

Applying filter to the 20 Hz Sine wave

Instructions
In the MATLAB command window
1. Type in the code below to apply filter to 20 Hz sine wave (Figure 11) : – fil=filter(Hd,xn);
Objects filter is now created in MATLAB
2. Type in the code below to plot the result: – plot(fil,'DisplayName','fil','YDataSource','fil');figure(gcf);
A 20 Hz Sine wave graph with the filter applied (Figure 12) is created.
3. By zooming into the graph you are able to search for the result (Figure 12)
Result after applying filter with 20 Hz Sine wave: – Noise level will be fine after 4000 samples

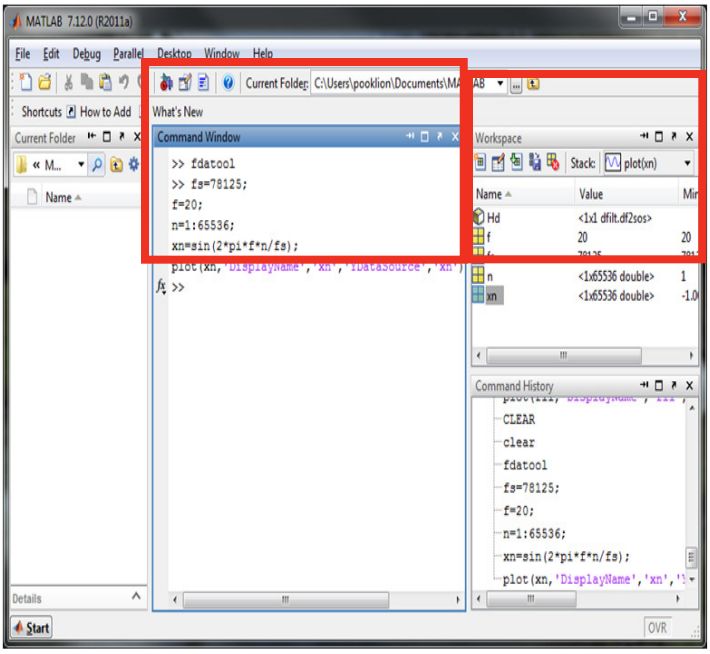


Figure 11. MATLAB command window and objects

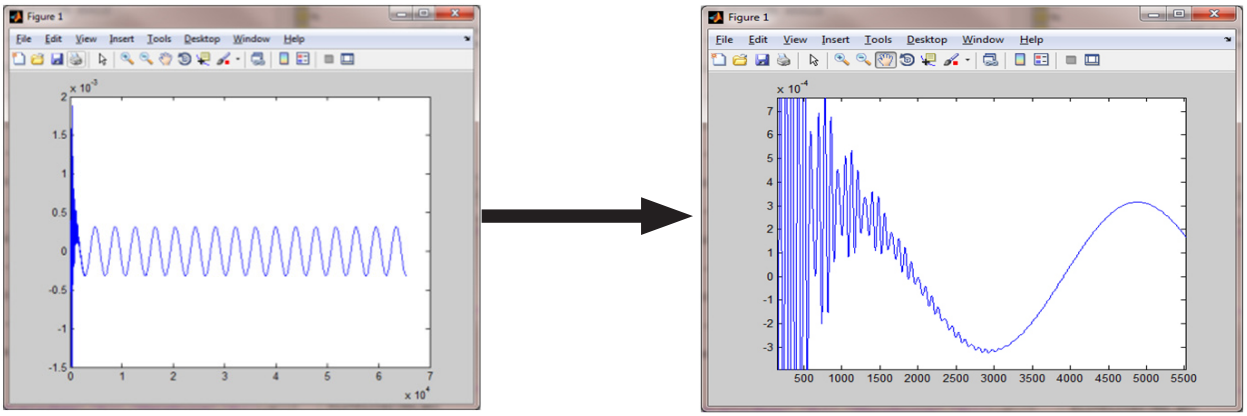


Figure 12. Zooming into the graph to see in-depth result

Step 5

Transfer coefficient data to *.juf file

Instructions
Information transfer and saving as a .juf file:
1. Name the *.juf file with a suitable title and bandwidth
2. Select Type (IIR or FIR)
3. Confirm Delay (Settling Samples)
4. Confirm Sections
5. Confirm Filter Coefficient Data

Design methods

There are different ways to transfer the Filter Coefficient data depending on the Design Methods (IIR or FIR)

Instructions
For Design Method FIR, enter the information below (Figure 13 and 14) :
1. '#Type: FIR"
2. '#Delay: ***" (From Settling Time/Delay)
3. "#Coefficients:"
4. Directly copy all the data from the Filter Coefficient data information (from Step 3)
5. Save the <anyname>.juf file

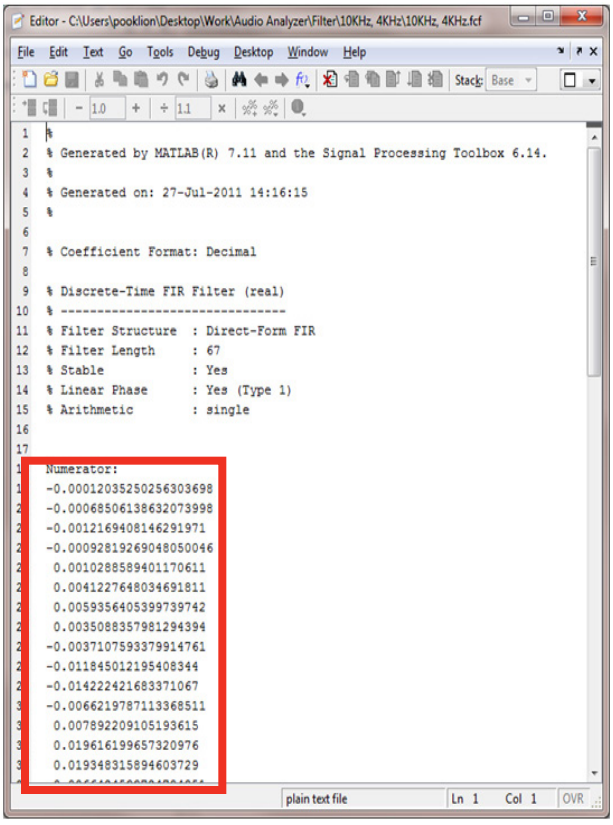


Figure 13. Filter Coefficient Data

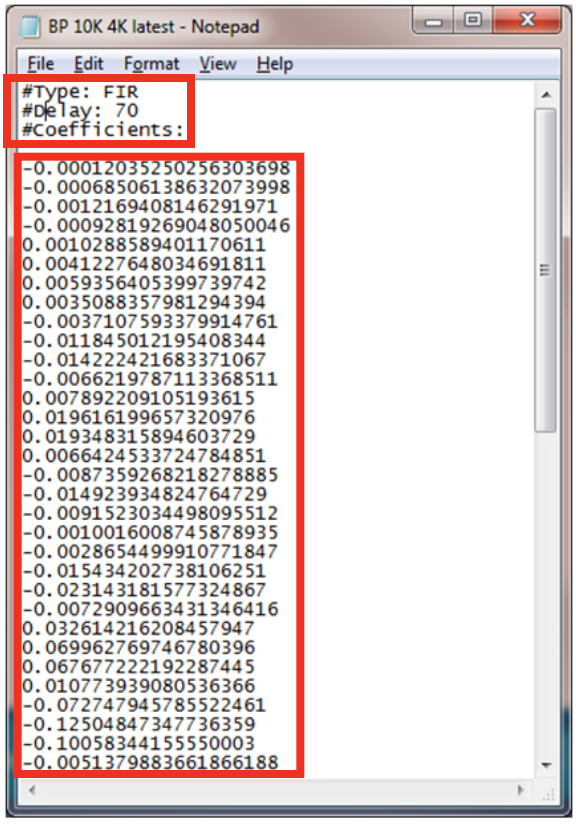


Figure 14. Example of Coefficient file

For the IIR Design Method, the transfer to .juf is relatively more complicated compared to the FIR Design Method

Instructions
For Design Method IIR, enter the information below (Figure 15 and 16):
1. '#Type: IIR"
2. '#Delay: ****" (From Settling Time/Delay)
3. "#Sections:"
4. Steps to transferring data: a. Scale Values b. Confirm second part of SOS matrix c. Confirm first part of SOS matrix d. Enter a blank line e. Continue from step a to step d for subsequent Scale Values.

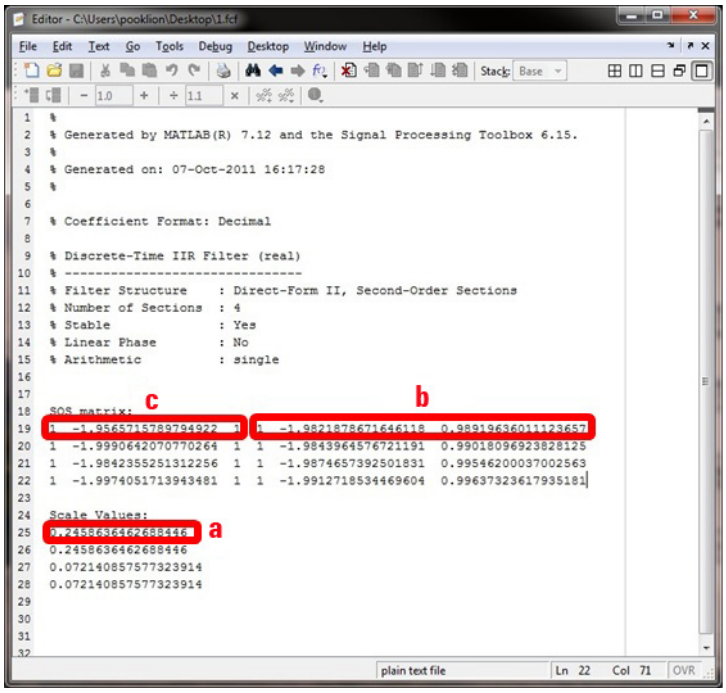
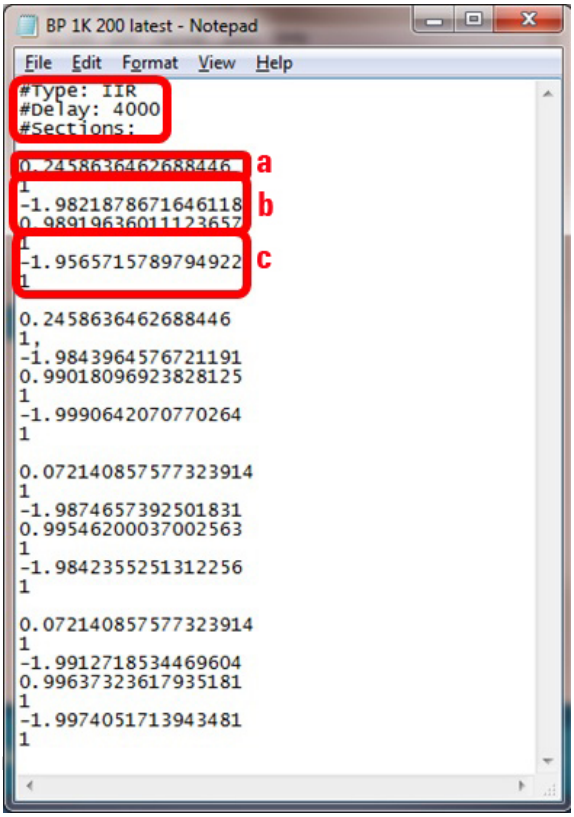


Figure 15. Filter Coefficient Data



Step 6

Upload .juf file to U8903A Audio Analyzer (Figure 17 and 18)

Instructions
1. Copy .juf file to a USB pen drive
2. Plug the USB pen drive into the U8903A Audio Analyzer
Steps to upload to the U8903A Audio Analyzer
3. Press " ▼" key to access AA1 mode
4. Press "Meas. Config" softkey
5. Press "Filter" softkey
6. Press either "LPF", "HPF", or "weighting" softkey
7. Select "Custom"
8. Press "Source" softkey
9. Press "Storage 1" softkey
10. Select the .juf file and press "Enter" key
11. The Filter will now be shown on either the LPF, HPF, or Weighting tab depending on your selection

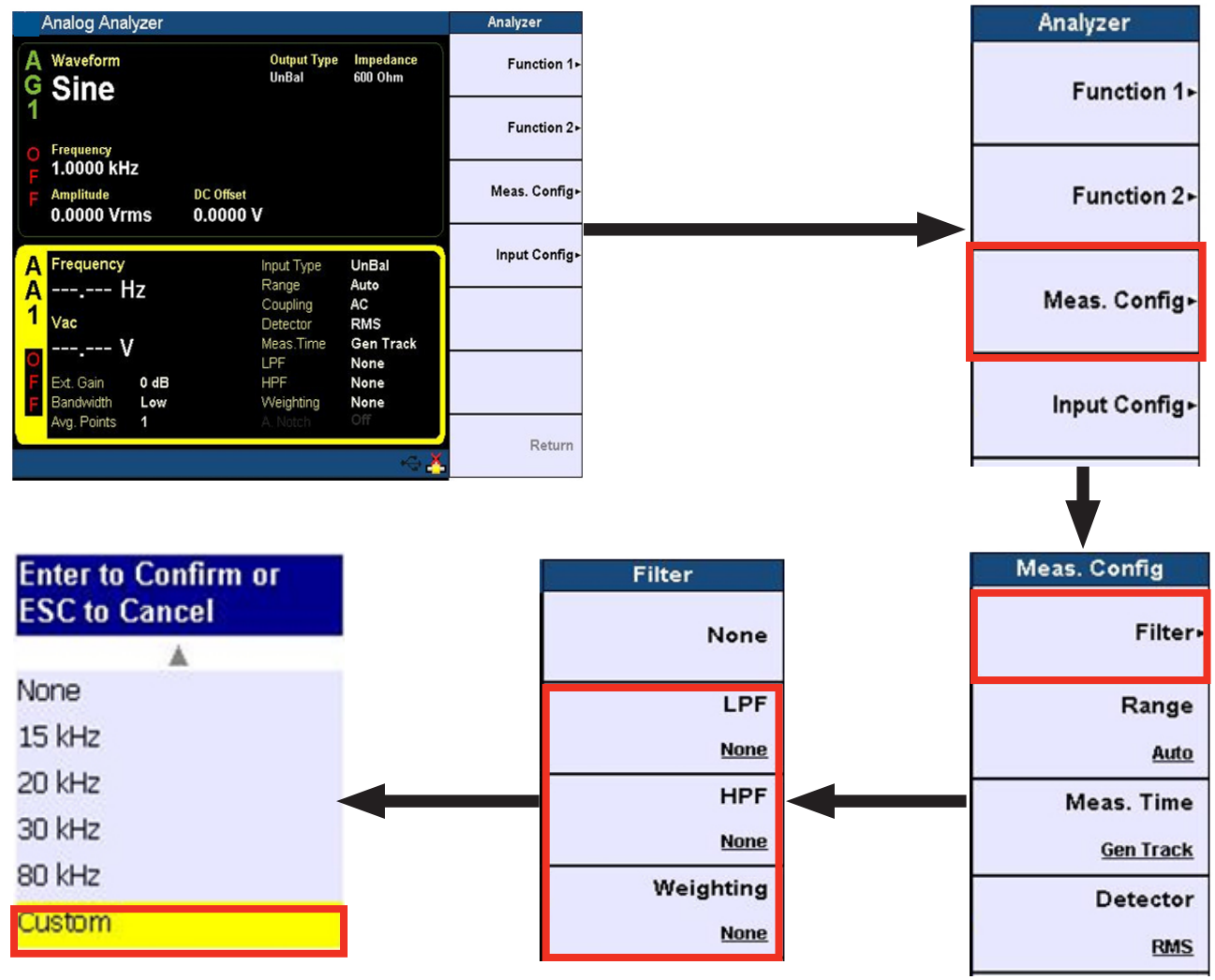


Figure 17. Uploading .juf file and selecting filter

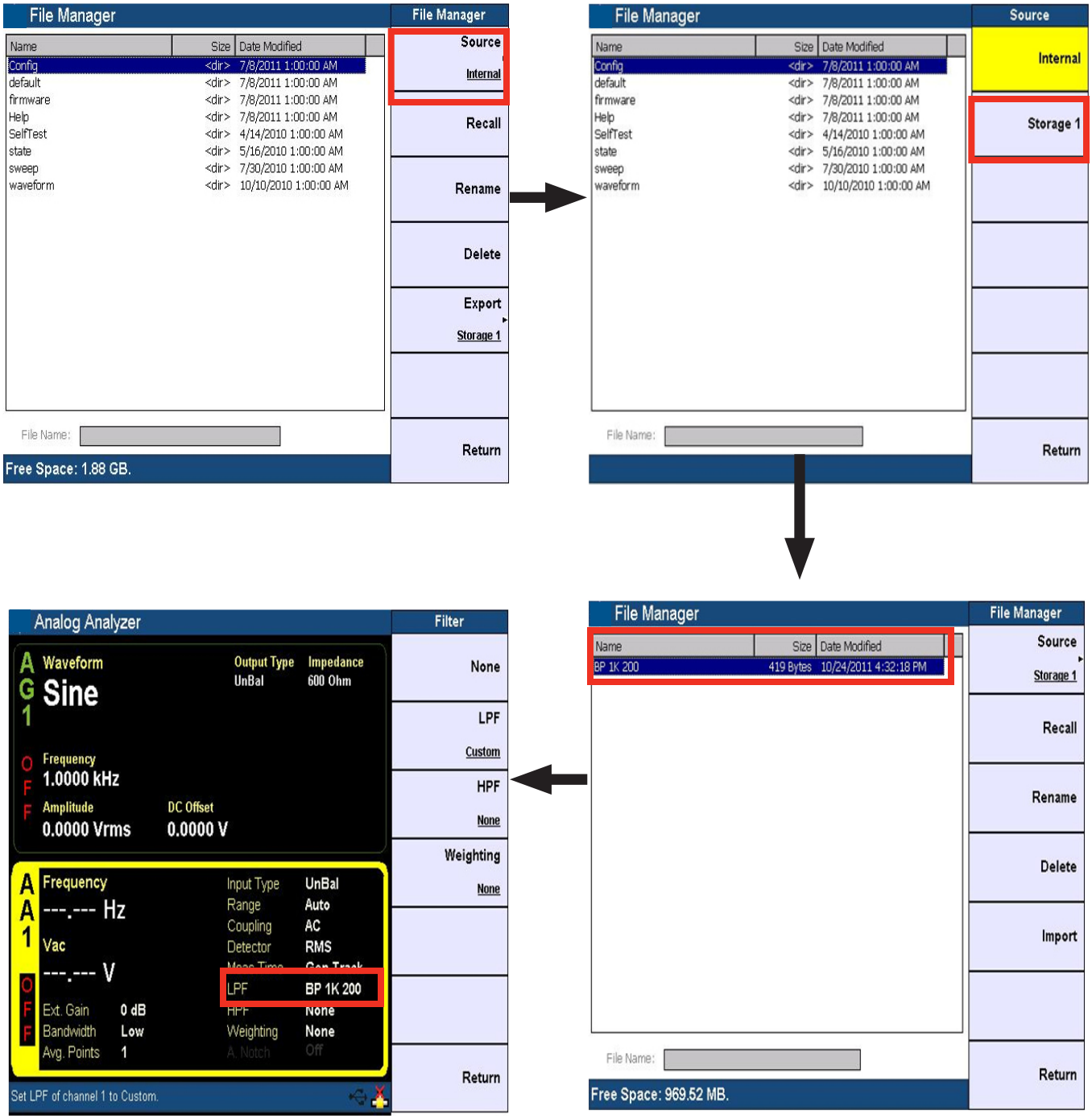


Figure 18. Selecting a source when uploading .juf file to U8903A

Conclusion

Due to differences in the testing environments and standards, general low pass filter, high pass filter, or weighting filter will only satisfy and fulfill some tests. Some users may require some custom filters in order to test DUTs. The U8903A Audio Analyzer provides users the capability to upload their own custom filter. This demonstration will enable users to create their custom filters with a computer using the MATLAB software.

Ordering Information

For further information, refer to *Keysight U8903A Audio Analyzer Quick Fact Sheet,* Literature Number 5990-8504EN.

Related Literature

- *Keysight U8903A Audio Analyzer*, *Data Sheet*, Literature Number 5990-8499EN
- *Keysight U8903A Audio Analyzer, Quick Start Guide,* Part Number U8903-90032

For the most up-to-date and complete application and product information, visit our product website at: **www.keysight.com/find/audioanalyzer**

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