NACT TUTORIAL 4
MEASURING DUT FREQUENCY RESPONSE

Applies to: NAT and NACT MODES

Prerequisites: Tutorials 0, 1, 2 and 3 (or 3T)

This tutorial takes you through the steps necessary to perform frequency scans on a basic DUT (Device Under Test). A "basic DUT" is one that does not require a test fixture and can be inserted directly into the test setup between the DDS output and the RF Power Meter input. Basic DUTs include RF filters, RF cables, attenuators, etc. The tutorial also covers the plotting, spooling, and playback of the scan results.

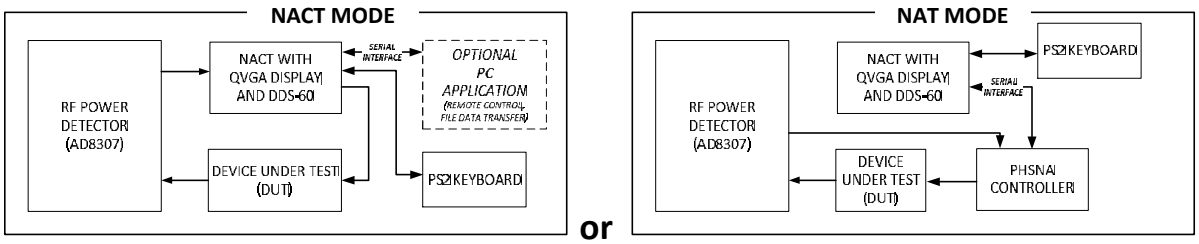
The requirements for this tutorial are:

- NAT running firmware Version 3.0 or later.
- Logarithmic RF Power Meter such as the RF Power meter designed by W7ZOI and W7PUA used by the PHSNA.
- PS2 Keyboard
- Basic Device Under Test (DUT)
- SD Card

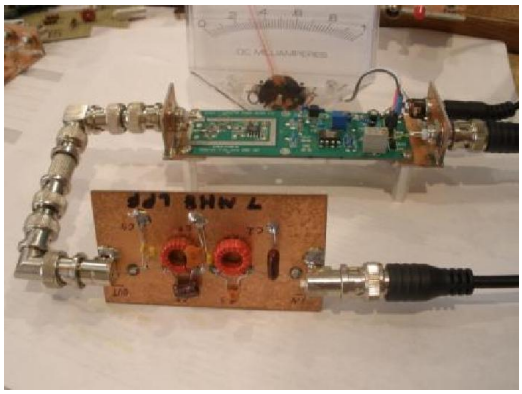
To operate in NAT mode you will also need the following:

- PHSNA Arduino UNO/NANO based controller.

You will also need all interconnecting cables and power sources.



1. Connect the output DUT input connector and the DUT output to the to the RF Power Meter input. Here my DUT is a prototype of a 7 MHz Low Pass Filter (LPF).



2. Make sure an SD card is plugged into the NAT.
3. Power on all components.
4. Create a PLX data sheet as follows:
    a. Press Scroll Lock to enter Command mode.
    b. Press F1 to display the data entry form
    c. Set up the F1 PLX data sheet to cover a frequency range of 1 MHz to 31 MHz with 50 KHz frequency increments and op modes specified for NAC (Network Analyzer Controller, if appropriate) and Signal generator modes.
    Enter the following on the form:

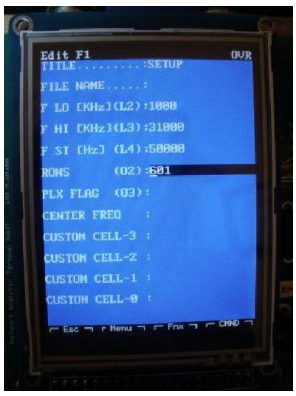
    page one:

    TITLE – SETUP
    FILE NAME – leave blank for now
    FREQ LO – 1000
    FREQ HI – 31000
    FREQ ST – 50000
    leave the rest of page one blank and press Page Down to display page two

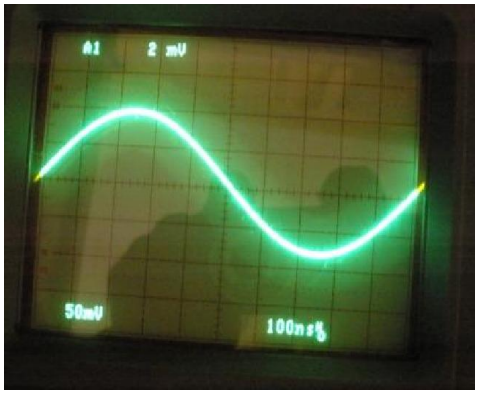
    page two:

    AUTO DELAY(ms) – 0
    XTAL PREFIX – leave blank
    OP MODES – C (if NACT mode blank otherwise)

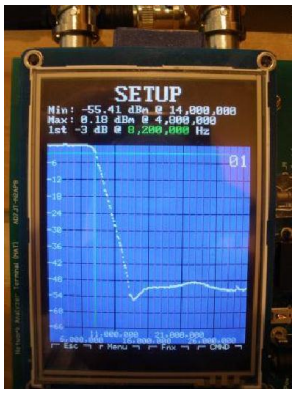
5. Press Enter to save the data sheet to EEPROM.



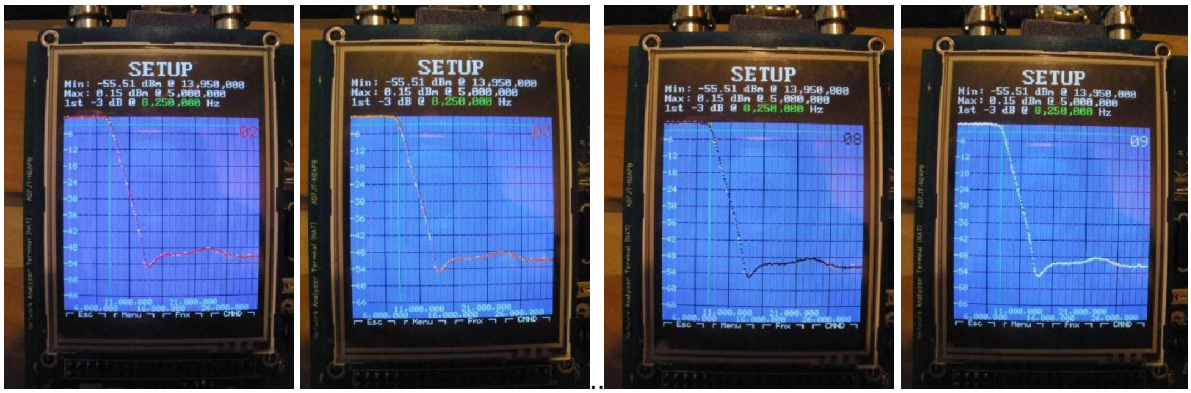
6. Press F1 to activate the data sheet.
   You should now see the sig gen screen and the DDS output should be 1 MHz.



7. Press the Space bar to start the frequency scan. After the scan, the results will be plotted.

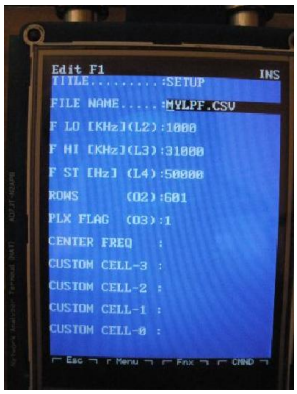


8. Each time you press the Space bar, the sweep will be repeated and the new data plotted over the previous data set(s). Each successive plot will be rendered in a different color from a set of eight colors. Plot number nine will go back to the first color and start the color sequence again. The color sequence is: white, red, orange, yellow, green, violet, gray, and black. The last plot number is displayed in the upper-right corner of the plot area in the same color as the corresponding plot. The information at the top of the display is not updated; it always applies only to the plot 01.



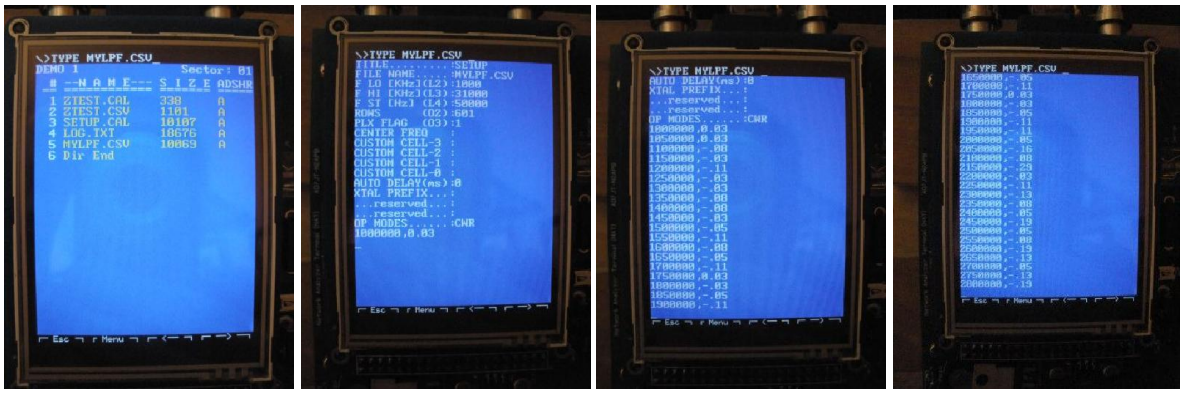
Note: If the R (Reinitialize each plot) op mode is selected on page two of the PLX data sheet, the total plot will be reinitialized for each scan and only one data set will be plotted at a time.

9. Press Escape to clear the plot and return to Terminal mode.
10. Press Ctrl-P to plot the data currently in the data buffer. This is a plot of the last scan of step 7. However, it is identified as the first scan here and the information at the top of the display applies to this data set.
11. Press Escape to clear the plot and return to Terminal mode.
12. Press and release Scroll Lock and F1 to edit the PLX data sheet.
13. Enter the file name “MYLPF.CSV” on page one and press Enter to save your change.

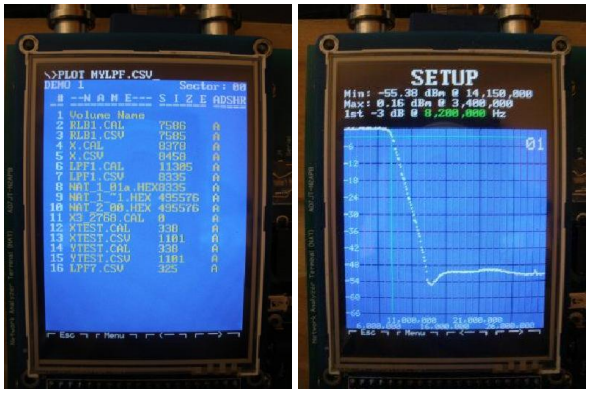


14. Press F1 to activate the data sheet and press the Space bar to run the scan and spool the results.
15. Press Escape to exit to Terminal mode.
16. Press and release Scroll Lock then Escape to go to DOS mode.

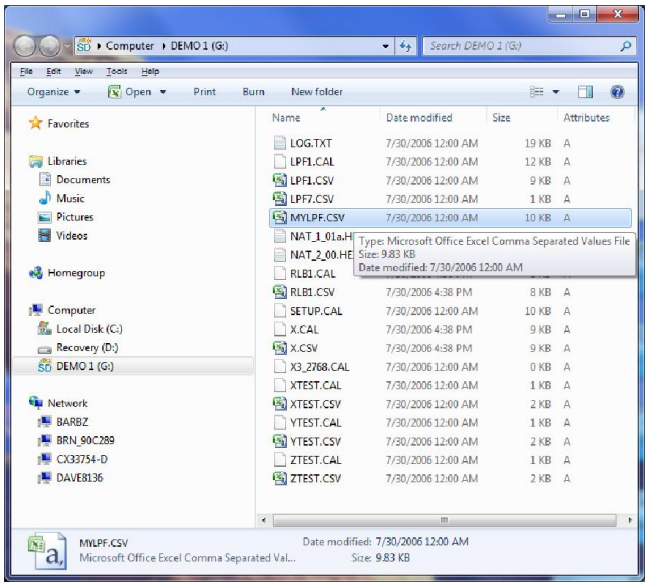
17. Verify anew file named “MYLPF.CSV” is in the root directory. If the root directory has more than 16 entries in it, you will have to use the Right Arrow key to navigate through the directory sectors. Enter the DOS command “TYPE MYLPF.CSV” and press Enter to execute the command. The first 18 lines of the file will be displayed. Each time the Space bar is pressed, the display will scroll up and the next 18 lines will be displayed.



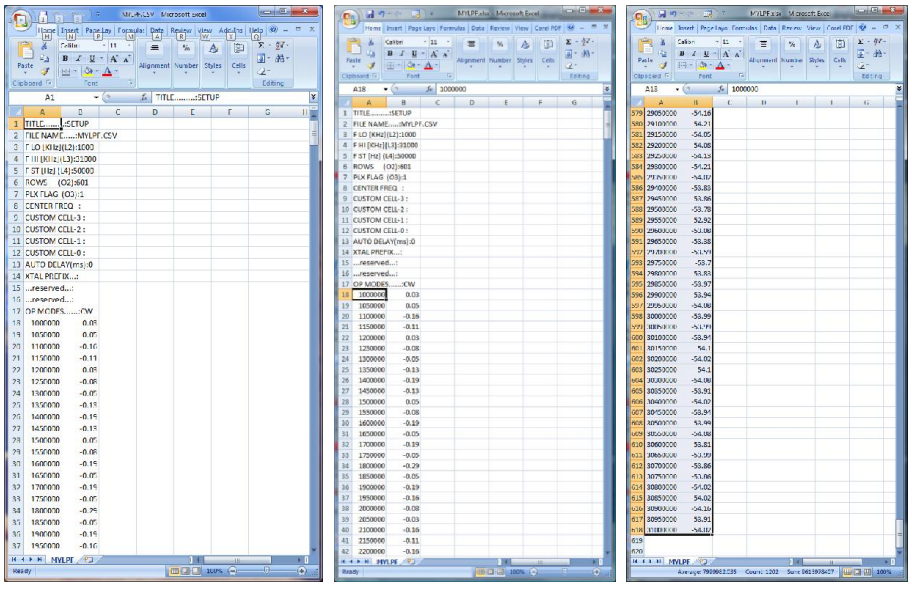
18. Press Escape to terminate the TYPE command and enter the command “PLOT MYLPF.CSV” and press Enter to execute the command. The data will be plotted and the display will look like the display from Step 7 which was generated directly from the frequency scan data.



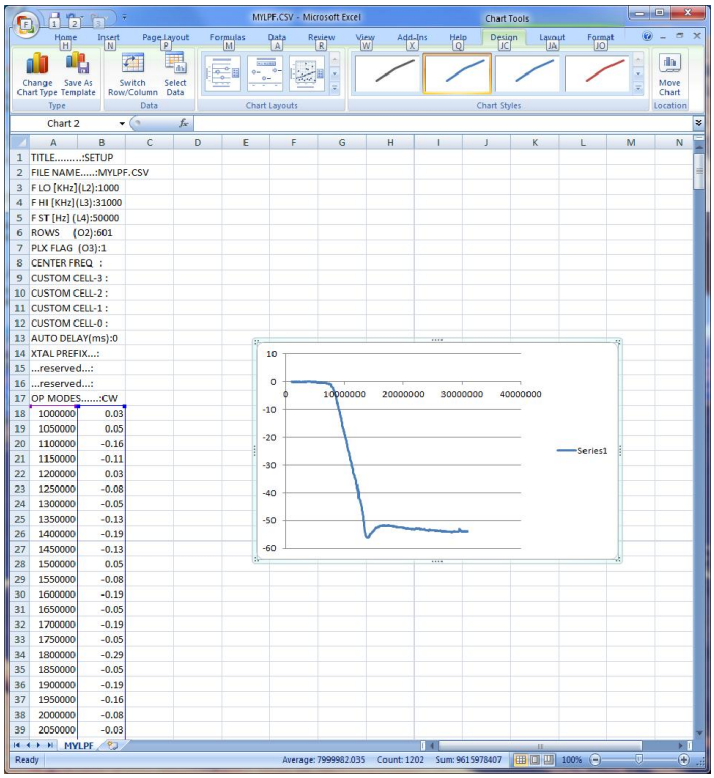
19. Remove the SD card and insert it into the appropriate slot in a PC. When the Auto Play window opens, select “Open folder to view files”.



20. Double-click on MYLPF.CSV to open it in Excel. Click once on the cell containing the first frequency (1000000). Scroll down to the bottom of the spread sheet. Hold the shift key down and click once on the cell containing the last dBm reading.



21. With the data still selected, select the Insert tab on the Excel menu bar then select Scatter from the charts section and, finally, select “Scatter with Straight Lines” from the drop-down list. The resulting data plot will be the same as was plotted on the NAT. Here you can dress up the chart by changing the size, colors, grid lines, etc.



	A	B
1	TITLE.....:SETUP	
2	FILE NAME.....:MYLPF.CSV	
3	F LO [KHz](L2):1000	
4	F HI [KHz] (L3):31000	
5	F ST [Hz] (L4):50000	
6	ROWS (O2):601	
7	PLX FLAG (O3):1	
8	CENTER FREQ :	
9	CUSTOM CELL-3 :	
10	CUSTOM CELL-2 :	
11	CUSTOM CELL-1 :	
12	CUSTOM CELL-0 :	
13	AUTO DELAY(ms):0	
14	XTAL PREFIX...:	
15	...reserved...:	
16	...reserved...:	
17	OP MODES.....:CW	
18	1000000	0.03
19	1050000	0.05
20	1100000	-0.16
21	1150000	-0.11
22	1200000	0.03
23	1250000	-0.08
24	1300000	-0.05
25	1350000	-0.13
26	1400000	-0.19
27	1450000	-0.13
28	1500000	0.05
29	1550000	-0.08
30	1600000	-0.19
31	1650000	-0.05
32	1700000	-0.19
33	1750000	-0.05
34	1800000	-0.29
35	1850000	-0.05
36	1900000	-0.19
37	1950000	-0.16
38	2000000	-0.08
39	2050000	-0.03

22. Return the SD card to the NAT and press Scroll Lock and Escape to get the DIR display. (Note that after “hot swapping” the SD card you may have to go through this procedure a couple times to get the SD card properly initialized.) Press Escape to return to Terminal mode.

23. Press F1 to activate the PLX data sheet. This time you will get a file system error indicating the specified file could not be opened because it already exists. The error message is only briefly displayed (along with a BEEP). Note that the scan(s) can still be done, there just will not be any data spooling. To be able to redo the scan and spool the new data you must do one of the following:
    a. Delete (or rename) the MYLPF.CSV file.
    b. Change or delete the file name on page one of the PLX data sheet.
    c. Specify the W (overWrite existing file) op mode on page two of the PLX data sheet.

24. Let's do option 'c'. Press Escape to return to Terminal mode.
25. Edit the PLX data sheet and add W to the op modes on page two and press Enter to save the change. Press F1 to activate the PLX data sheet. Now there is no file system error and each time you press the Space bar, the file will be deleted and rewritten with the new data.
26. Edit the PLX data sheet page one and delete the file name entry. Press Page Down to go to page two. Delete the "W" from and add "A" (Automatic start) to the op modes entry. Press Enter to save the changes.
27. Press F1 to activate the PLX data sheet. This time the scan will start without you pressing the Space bar and scans will be repeated as fast as they can be done (usually more than two times per second). The results from each scan will be added to the plot until the plot number reaches 99. At this point the plot screen will be reinitialized and the plot counter reset. The next plot will be plot number 01. The Automatic start op mode is especially useful when the DUT has tunable elements in it. The plots will show the effects of any tuning done while the scans are in process making it easy to see any differences. Delays can be introduced between scans by entering the number of milliseconds to delay in the AUTO DELAY (ms) entry on page two of the PLX data sheet.
28. Press Escape ('M' for "Manual") to turn Automatic start off, the action will stop at the end of the current sweep.
29. Press A to turn Automatic start on and press the Space bar to start the first sweep.
30. Press Escape twice to disable Automatic start, return to Terminal mode, and end this tutorial.