OML Spur Calculator Program

Background

The OML Spur Calculator program has been designed to predict the intermodulation (IM) product outputs (Spurs). They are produced in a signal mixing process and can exit the mixer (converter) from any port. The scope of this program is limited to analyzing spurious products produced in the typical "block converter". Some degree of familiarity with mixer spur analysis on the part of the user is assumed.

A block converter is defined for our purposes as a mixer whose input is restricted to one fixed frequency, typically thought of as the LO or conversion signal. The mixer's input is also restricted to one band limited variable frequency, typically thought of as an IF or RF signal. To maximize the program's versatility, a mixer will be referred to as either an upconverter or a downconverter. This allows us to address Inputs and Outputs without worrying about RF and IF ports; a limitation found in most mixer spurious prediction programs.

Software Operation

In Windows 95/98, the calculator is started by selecting START/Program Files/OML/SPUR Calculator. An intro screen will appear, prompting the user to press the START button. At this point, the user can freely enter the appropriate values for calculation. The following is a screen dump of the Spur Calculator. (See Figure 1)

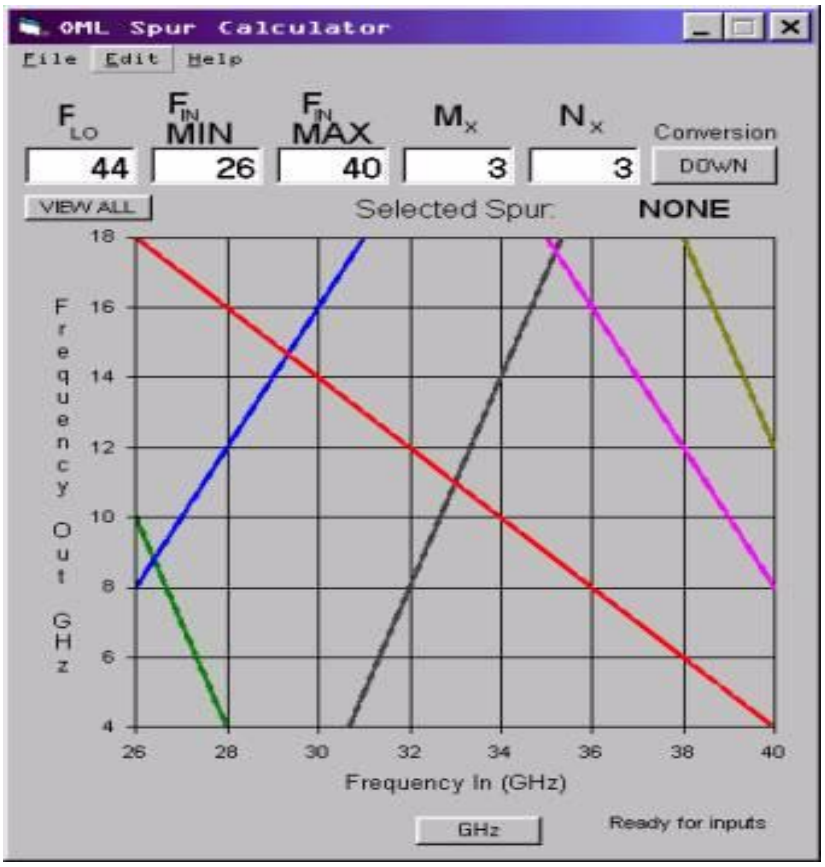

Figure 1 – Screen dump of Spur Calculator

Spurs are calculated based on input frequencies that can be entered in either MHz or GHz with the field limited to 999.9. Pressing the button located at the bottom of the screen chooses either MHz or GHz. The input signal (the variable frequency) can act as either an RF signal for down-conversion or as an IF signal for up-conversion. This function is chosen by selecting "Conversion" to be "UP" or "DOWN". The low and high input frequencies are entered as "F_{IN} MIN" and "F_{IN} MAX". The harmonics of the variable signal generated in the mixing process have been historically labeled as "M". This variable represents the specific harmonic of the variable frequency signal created (i.e. 1st, 2nd, 3rd, etc.). The fixed frequency signal functions as the conversion signal (LO) and is entered as "F_{LO}". The harmonics of the LO have been historically labeled as "N" where "N" represents the specific harmonic of a fixed frequency signal. The pairing of an "M" and an "N" describe a specific Spur that can be created, i.e.[-2, 3] represents a Spur whose factors are 3 times the LO minus 2 times the variable frequency Input. The range of the "M" and "N" harmonics is limited to 9 in the software. The upper multiple limit of each harmonic to be analyzed is entered under "M_x" and "N_x". Each time the operator enters a new value in one of the five fields and presses the enter key or changes the conversion type, the software automatically recalculates the new spurs.

The graph created by this analysis can display spurs anywhere from the conversion product, [1, -1] or [-1,1] (a single line) to the factorials of [-9, 9] plus [9, -9] (a great many lines). The calculator performs its computation with 1/10 resolution. The calculator can also identify "single point" Spurs where the Spur product lies outside of the band of interest and only intrudes at either the "F_{IN} MIN" or "F_{IN} MAX" frequency. When such a Spur occurs, a button entitled "SPS" at the top of the graph will appear. Highlighting a specific Spur line of the graph with the mouse pointer will cause the mathematical product of that Spur to be displayed to the right of "Selected Spur". A tabular listing of the range of the Spur products can be viewed by clicking "View All" with the SPS button functioning similarly. These features offer road maps for the actual measurement of the Spur levels. As a practical matter, "M_x" and "N_x" factors of greater than 5 tend to create Spur levels which are very low in relation to the desired Output signal (dBc/Output).

The calculator also allows the user to save the calculated data by selecting the FILE/Save function from the menu bar. Before saving to disk, the software will perform a recalculation if the data does not reflect the user entered fields, ensuring that the results are up-to-date. The save function saves the data in a text format, with a Microsoft Excel extension, allowing it to be imported into Excel with minimal effort.

The user can also acquire a screen dump of the calculator results, either on hardcopy or via the Windows Clipboard. To acquire a hardcopy, select FILE/Print from the menu bar. This will send an image of the current screen to the system default printer. This function also recalculates if the graph does not reflect the user entered fields. To acquire a Windows Clipboard image simply select EDIT/Copy. This allows the user to import the graphical results into any Windows application that supports bitmap pasting, such as MS. Word, Excel, Paint-Brush, etc.

The user should be aware that OML Spur Calculator is a very computationally intensive program that can generate huge output files. This is because calculations occur in 0.1 steps over the FIN range for every Mx, Nx pair. For example, the inputs: LO = 500, FIN MIN = 501, FIN MAX = 999, Mx = 2, Nx = 2 can take several minutes to process even on a relatively fast PC.