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Texas Instruments PLL Loop Filter Simulator – HELP FILE –

This tool can assist designing a 3rd order Low-Pass filters to optimize the PLL loop bandwidth for various TI clock generator products.

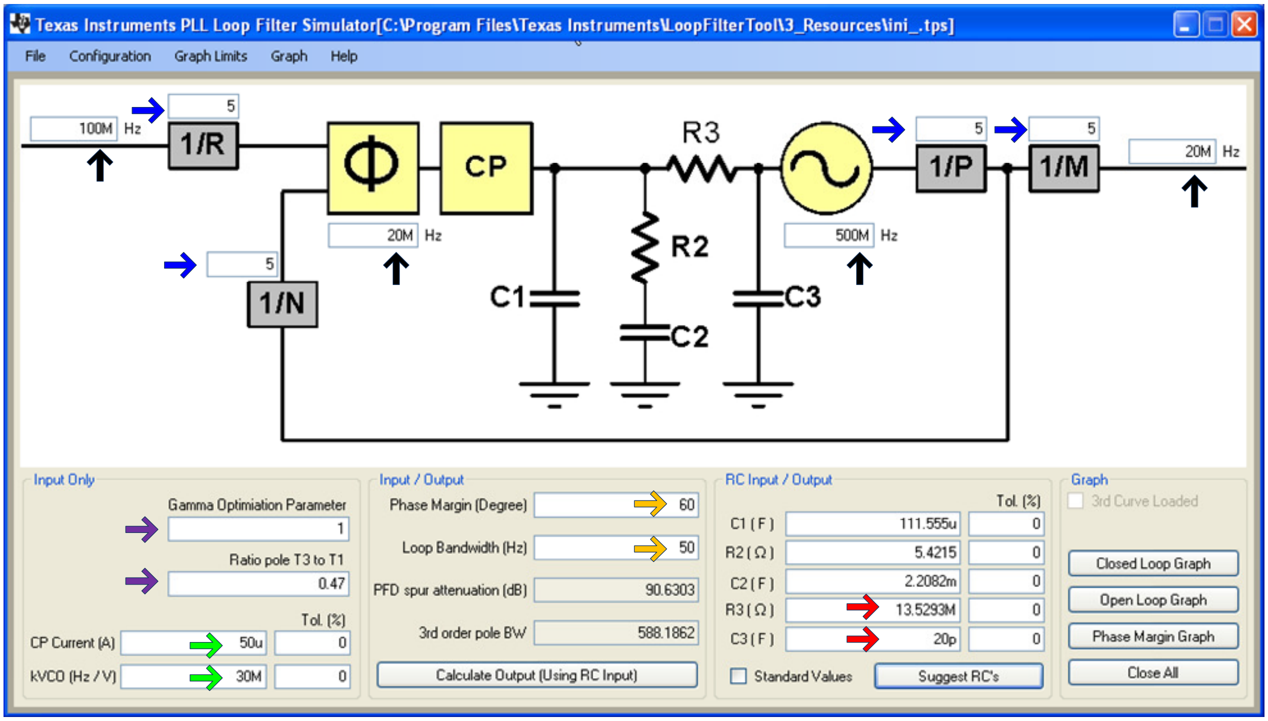

Figure 1

Suggested Flow

1. Start by entering a target frequency into one of the four frequency fields. Other frequencies will be automatically calculated according to divider settings. ↑
2. Enter values for each of the dividers. →
3. Input the appropriate values for CP Current and kVCO. Charge pump current is usually selectable from a number of values for a specific clock device and can be found in the datasheet. In general, choose a lower charge pump current if a lower loop bandwidth is desired. kVCO refers to the tuning sensitivity of the VCO, and can be found in the device datasheet or VCXO datasheet when an external VCXO is used. If this value is not provided specifically in the datasheet, it can be calculated by using the ppm tuning range and tuning voltage range; typically this value is on the order of 10kHz/V for an external VCXO. →
4. Enter the desired phase margin and loop bandwidth for the filter. We generally recommend a phase margin of 45-70 degrees for stable PLL operation. When in doubt, select 65 degrees. For loop bandwidth, a higher bandwidth is desired when the phase noise of the input clock is lower than that of the VCO. For example,

when using a crystal, the bandwidth should be set to > 100kHz. Otherwise, use a low bandwidth (<< 1kHz) if the input clock is very noisy (i.e. recovered CDR clock). →

5. R3 and C3 are sometimes internal to the clock chip. If so, input valid values here from the datasheet to set the 3rd pole. →
6. (Optional Advanced Step) Gamma impacts lock time and spur gain. Default gamma is 1. T31 sets the ratio between the first pole (2nd order filter) and the 3rd pole (R3/C3). Setting this parameter to 0 effectively turns this 3rd order filter into a 2nd order filter. Setting to 1 theoretically maximizes the spur attenuation, although practically spur attenuation is already maximized at T31 of 0.62. Default is 0.42 (42%). Aim to maximize T31 without making C3 smaller than $3xC_{IN}$(VCO). →
7. Click on the ‘Suggest RC’s’ button to generate RC recommendations. Click the ‘Standard Values’ check box if desired to limit recommendations to common available R and C values.
8. Click ‘Calculate Output (Using RC Input)’ button to recalculate the loop bandwidth based on adjusted R and C values.

Loop Analysis

Finally the Open Loop, Closed Loop, and Phase noise Performance can be analyzed using the buttons from the Graph panel. Click on any point on the curve to display X and Y information. Graph limits can be adjusted as needed from the ‘Graph Limits’ menu.

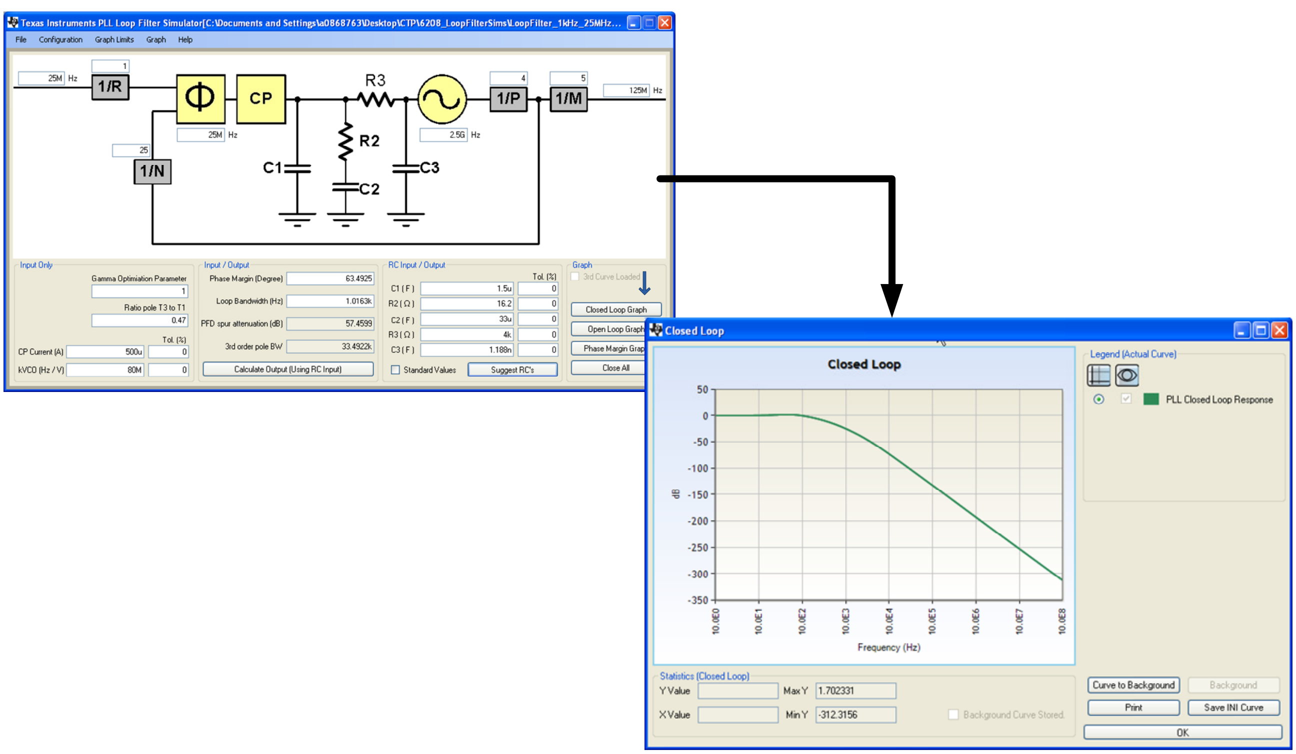

Figure 2

Graphing Tool Features

The graphing tool offers the ability to save a curve to the background or to an INI file to be used at a later time as demonstrated in Figure 3. The check-boxes in the legend can be used to display or hide the different curves and control which curve's X/Y values are shown. The settings of the main Loop Filter Tool window can also be saved and reloaded from the File menu.

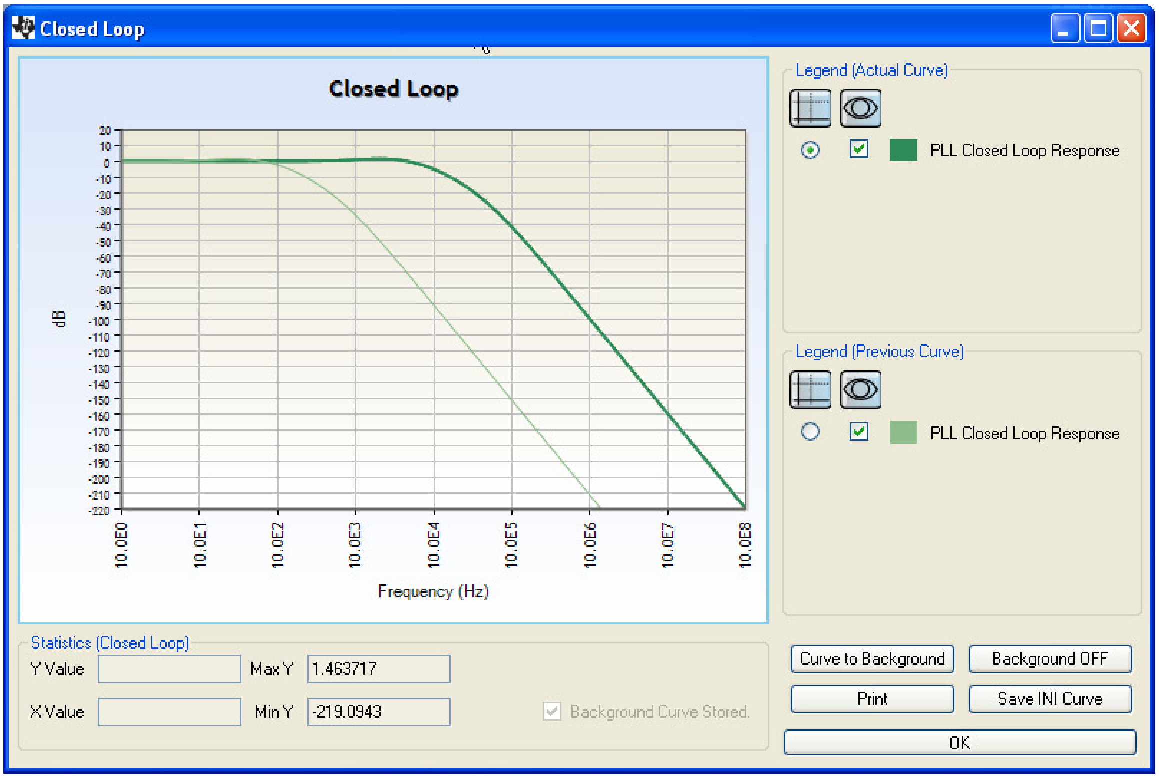

Figure 3