AN2455
Application note

STWPLLSim phase noise and settling time simulator for STW8110x

Application and scope

The STWPLLSim tool helps the end user to design the optimal loop filter for the STW81101x synthesizers. It provides a very accurate estimation of the overall phase noise and settling time performances, allowing the user to interactively compare measurements with simulated performance.

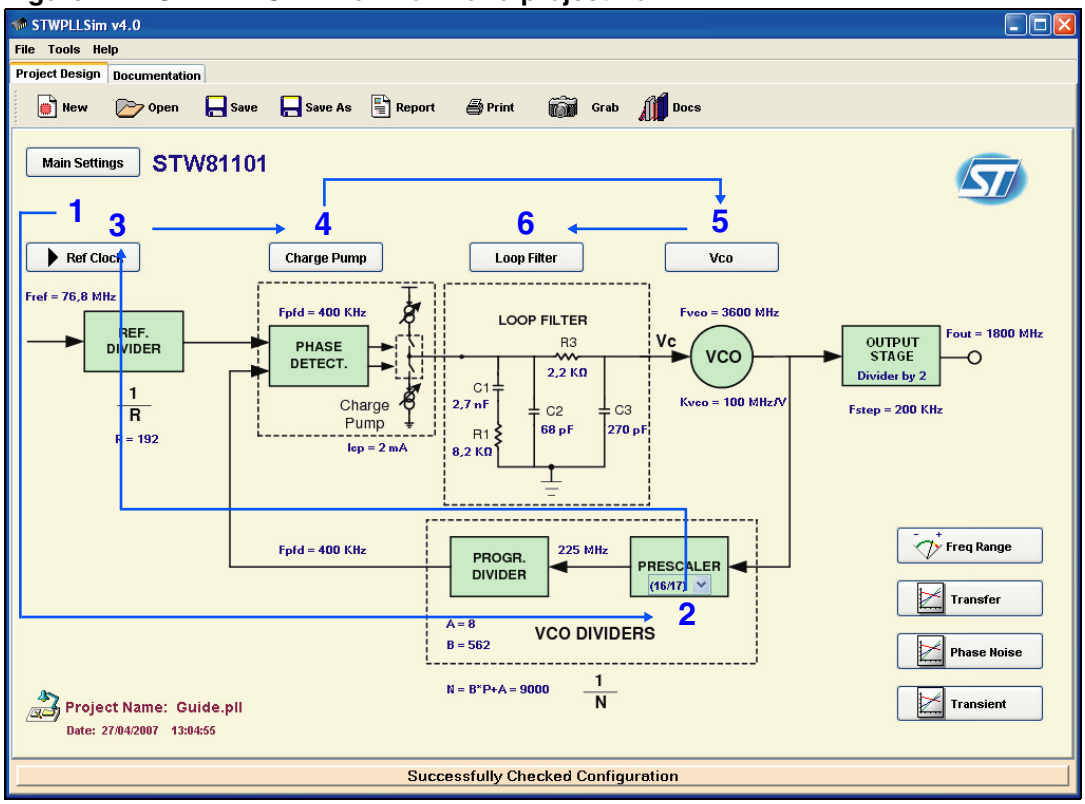
1 Installation

The STWPLLSim software is written in Java and designed to run on Windows 2000/XP. To perform time domain simulations, STWPLLSim requires the MATLAB Component Runtime (MCR) Libraries (Copyright 1984-2005, The MathWorks, Inc. See *http://www.mathworks.com/access/helpdesk/help/toolbox/compiler/index.html?/access/helpdesk/help/toolbox/compiler/f12-999353.html*).

Run *SETUP.bat* to install STWPLLSim.

2 Main form

Figure 1. STWPLLSim: main form and project flow



2.1 Creating and managing projects

New and **Open** buttons allow the user to create a new project or to open an existing one.

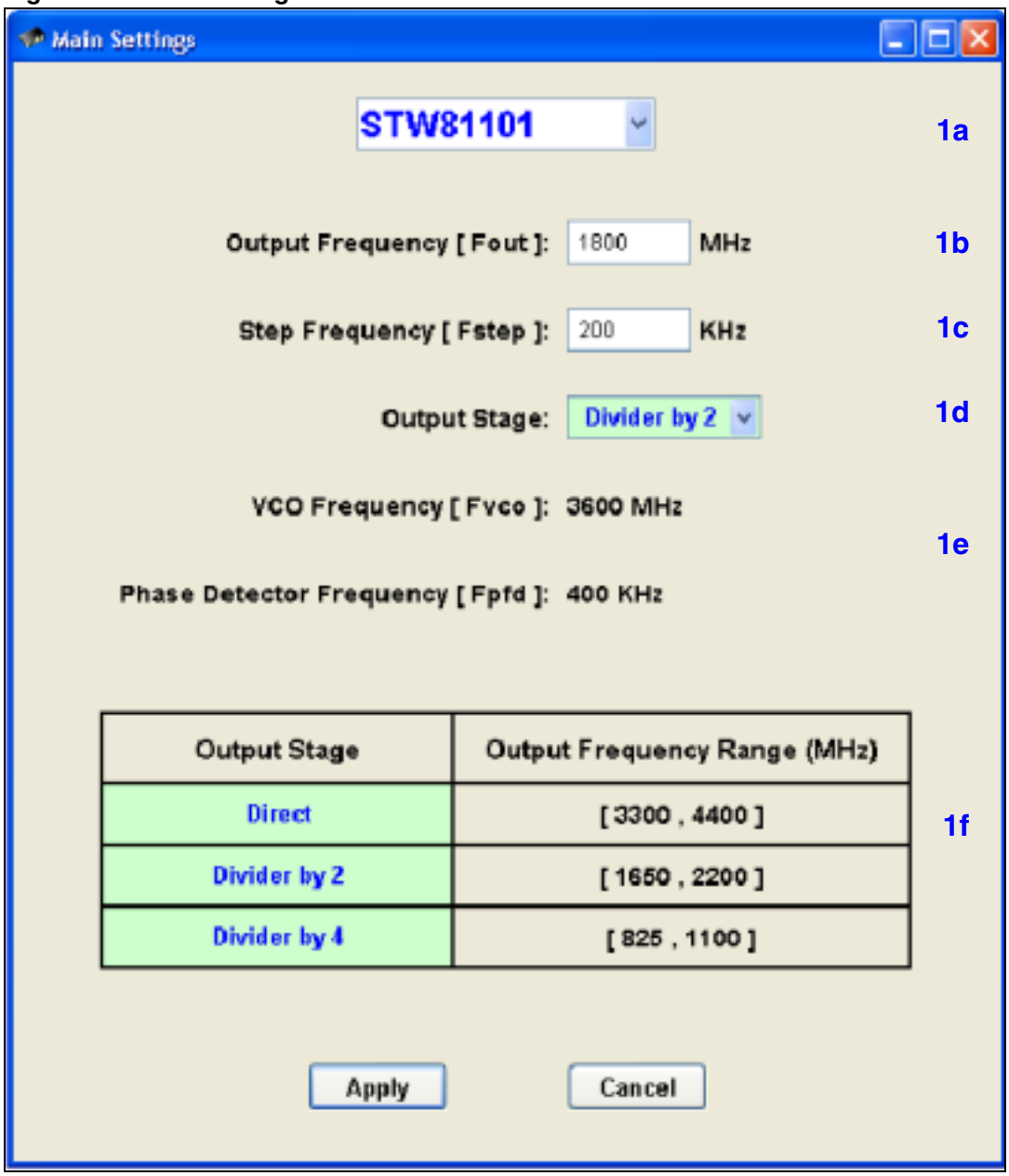
The project can be saved by pressing the **Save** / **Save As** buttons.

2.2 Project flow

These are the steps to follow in using STWPLLSim, as shown in *Figure 1*:

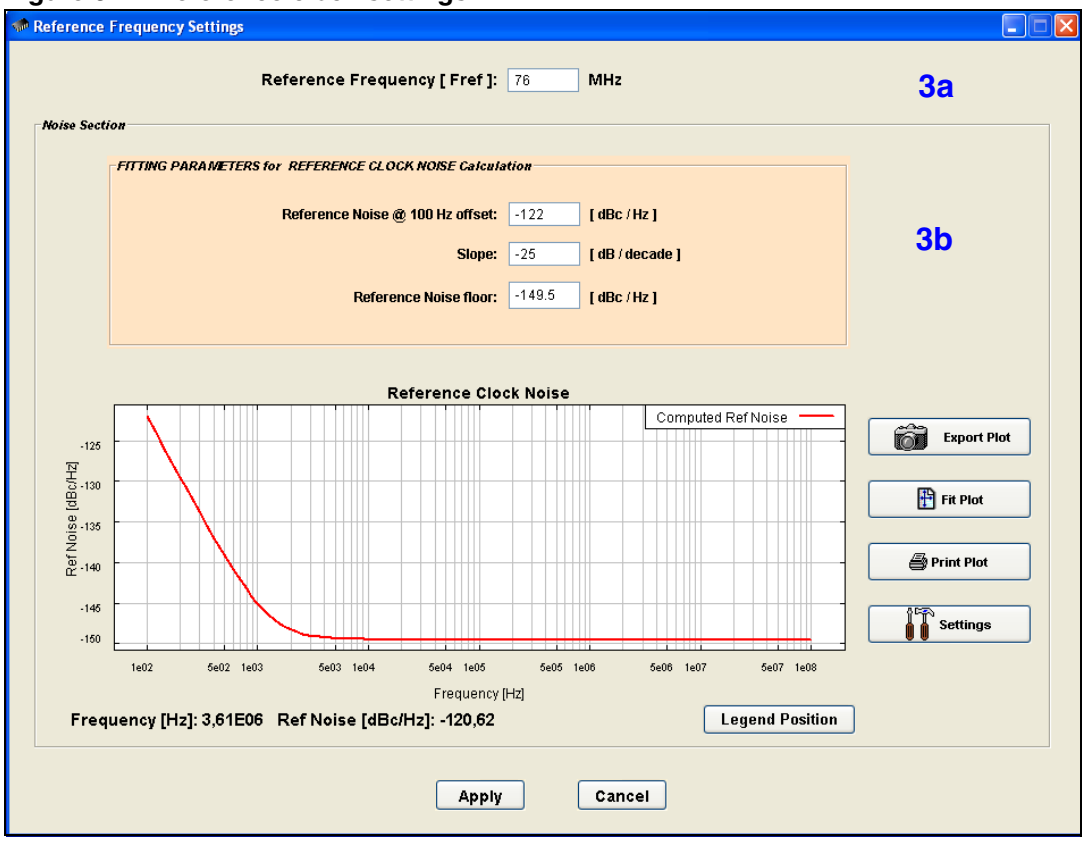
1. Main settings (see the screenshot in *Figure 2*):
   a) Device choice (STW81101, STW81102, STW81103)
   b) Output frequency [MHz]
   c) Frequency step [kHz]
   d) Output stage (direct output, divider by 2, divider by 4)
   e) VCO and phase detector frequencies are calculated from the inserted data.
   f) A table helps to choose the correct output stage depending on the desired output frequency and the selected device.

Figure 2. Main settings



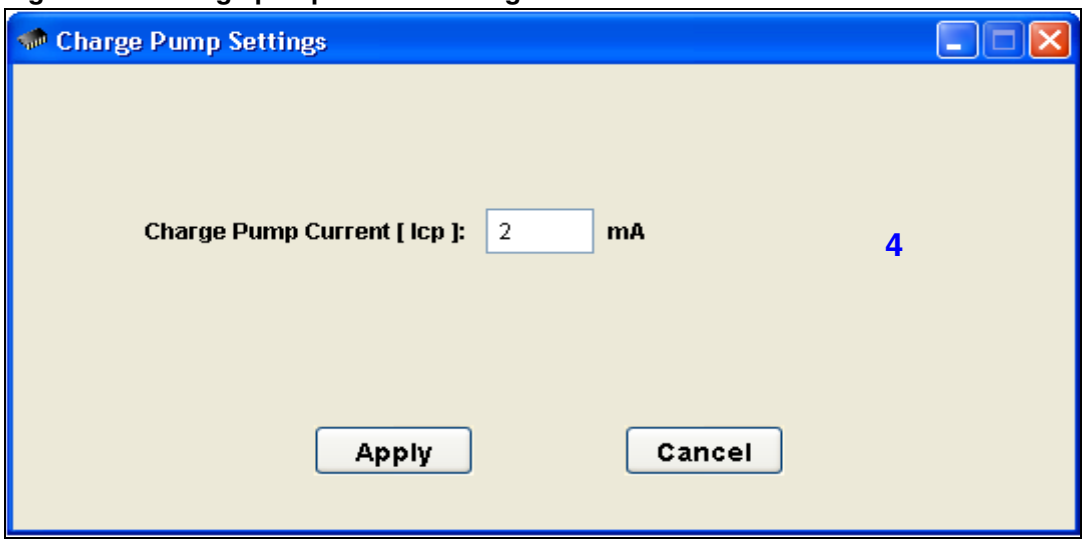
2. Prescaler: select the prescaler (either 16/17 or 19/20).
3. Reference clock (see the screenshot in *Figure 3*):
   a) Reference frequency
   b) Fitting parameters for phase noise performance

Figure 3. Reference clock settings



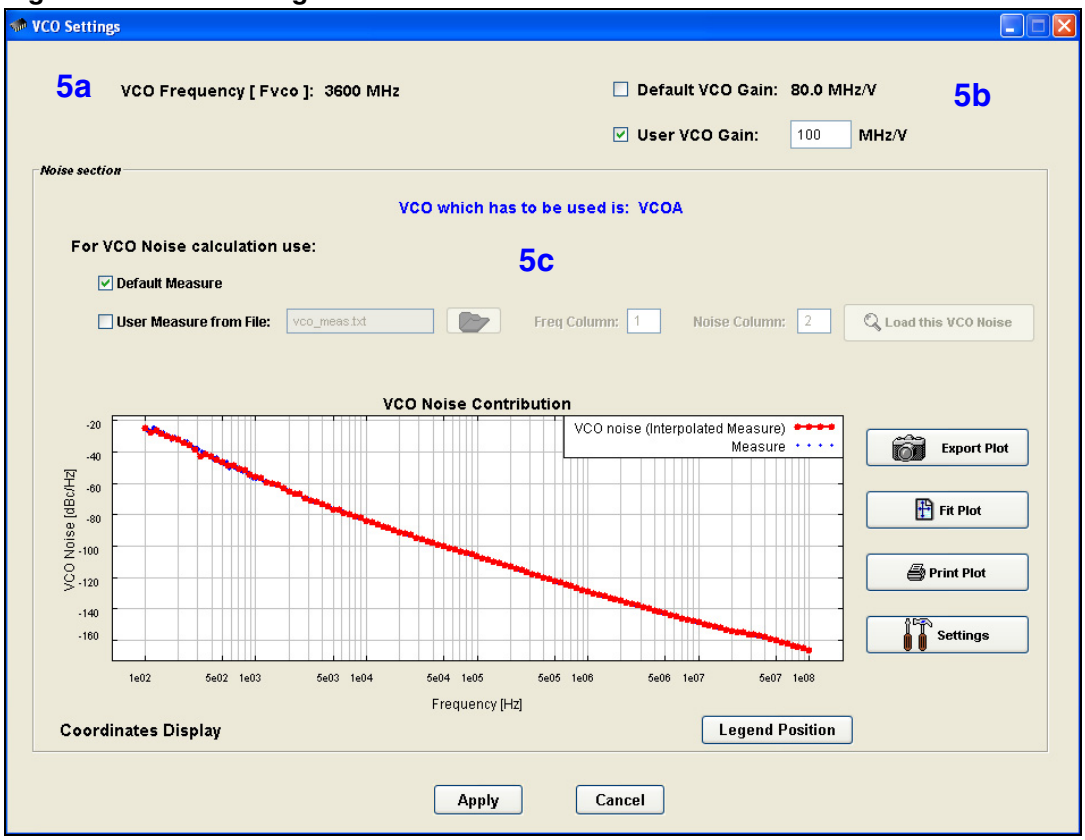
4. Charge pump current [mA] (see the screenshot in *Figure 4*):

Figure 4. Charge pump current settings



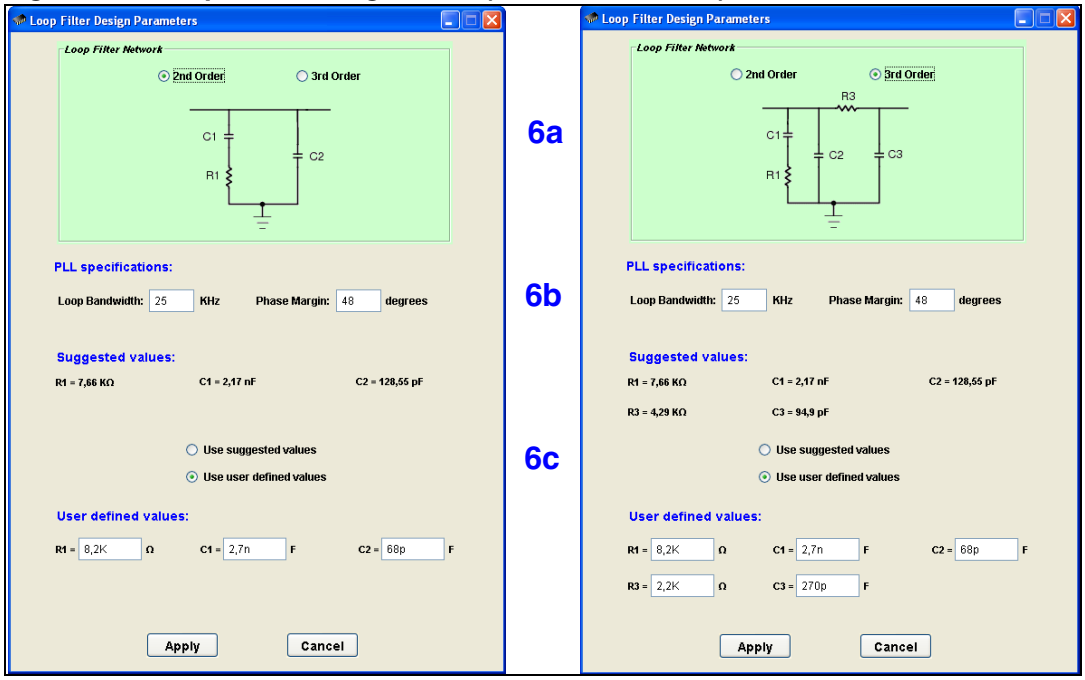
5. VCO (see the screenshot in *Figure 5*):
   a) The VCO frequency set in the main settings form is shown.
   b) A typical VCO gain is set depending on the VCO frequency. This value can be changed by the user.
   c) A default or a user measure file can be loaded for the noise calculation.

Figure 5. VCO settings



6. Loop filter (see the screenshot in *Figure 6*):
   a) Loop filter network:
      - 2nd order
      - 3rd order
   b) PLL specifications:
      - Suggested loop BW $\leq F_{comp}/10$
      - Suggested (and default) phase margin = 48° (best trade-off between phase noise and settling time performance)
   c) Suggested or user defined values for resistances and capacitances can be used. Valid unit prefixes are "K" for resistances and "n" and "p" for capacitances.

Figure 6. Loop filter settings forms (2nd and 3rd order)



3 Waveform viewers

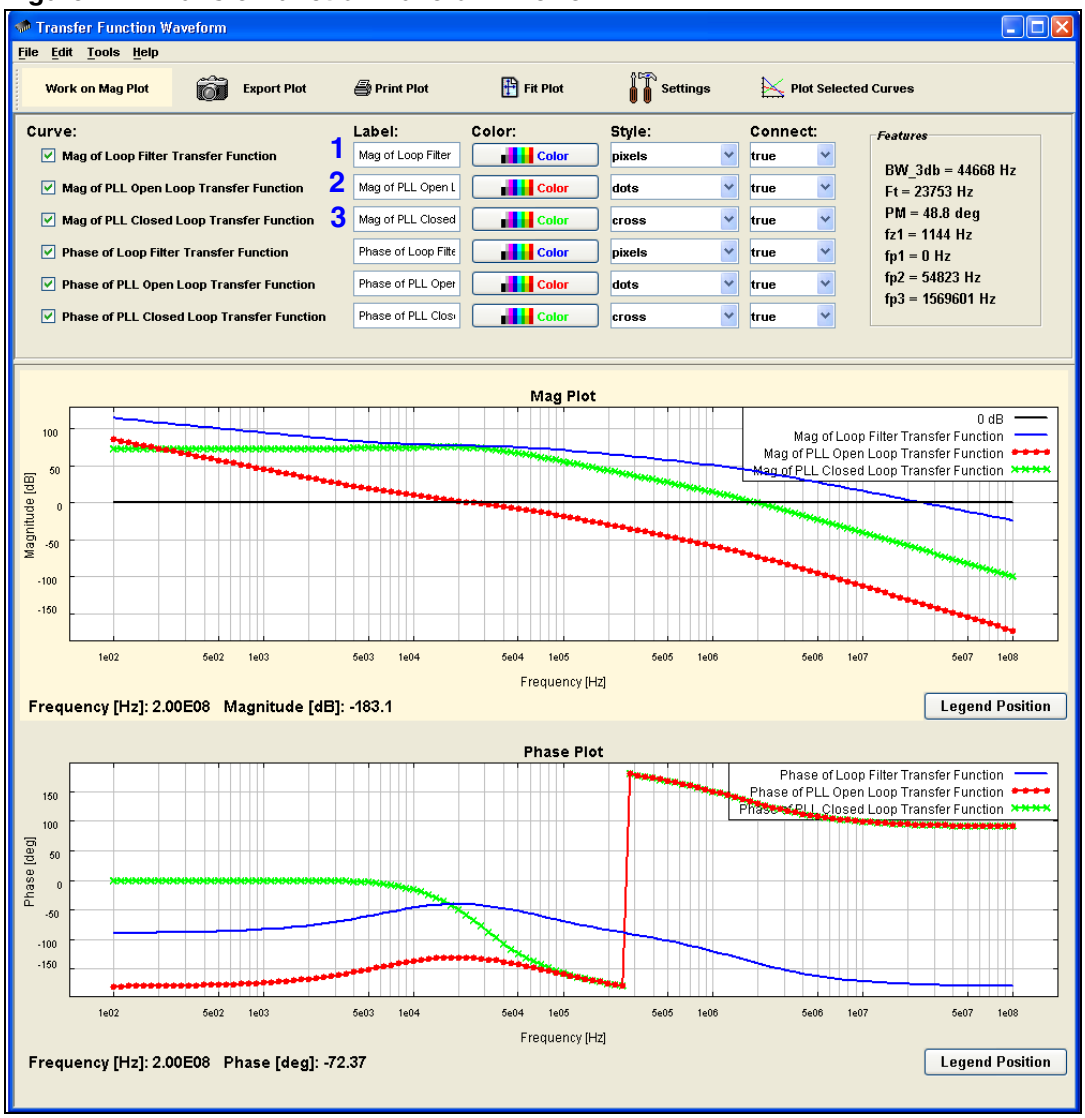
Waveform viewers are available for transfer functions, phase noise and transient response.

3.1 Transfer functions

The magnitude and phase of the following transfer functions can be plotted:

1. Loop filter
2. PLL open loop
3. PLL closed loop

Figure 7. Transfer function waveform viewer



After selecting the waveforms to plot, press the **Plot Selected Curves** button. You can modify the frequency range from the main form by clicking the **Freq Range** button.

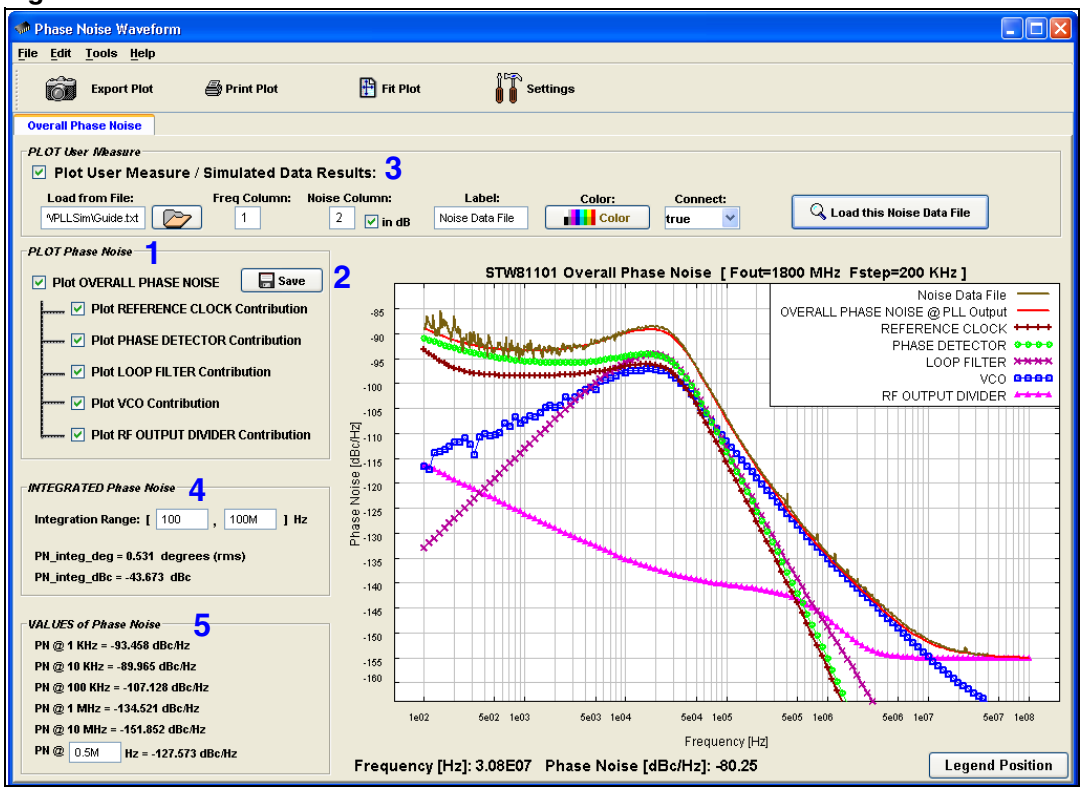
3.2 Phase noise

The following functions are available in the phase noise waveform viewer:

1. Plot the overall phase noise and the following contributions:
   - reference clock
   - phase detector
   - loop filter
   - VCO
   - RF output divider
2. Save the overall phase noise to a text file.
3. Load user measure/simulated data from a text file.
4. Calculate the integrated phase noise by inserting the integration range limits and pressing **Enter**. “K” and “M” are valid unit prefixes for the frequency.
5. Calculate phase noise values for five fixed frequencies and for one user frequency.

You can modify the frequency range from the main form by clicking the **Freq Range** button.

Figure 8. Phase noise waveform viewer



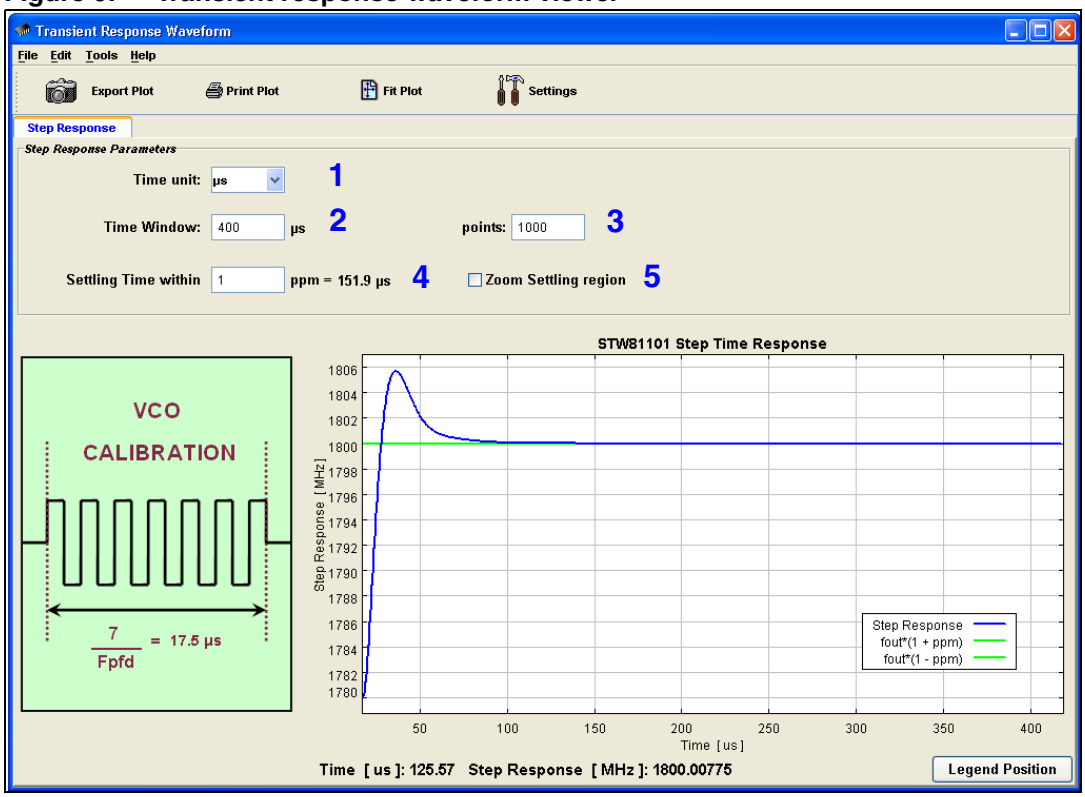
3.3 Transient response

The step time response is plotted and the following parameters can be set:

1. Time unit (µs or ms)
2. Time window: if the specified time window value is lower than the settling time, a warning message is shown.
3. Points
4. Settling time (frequency error, in ppm, with respect to the F_{out} final value)
5. Zoom on settling region (default: on)

The VCO calibration time is calculated according to the F_{comp} value and taken into account in the settling time value.

Figure 9. Transient response waveform viewer

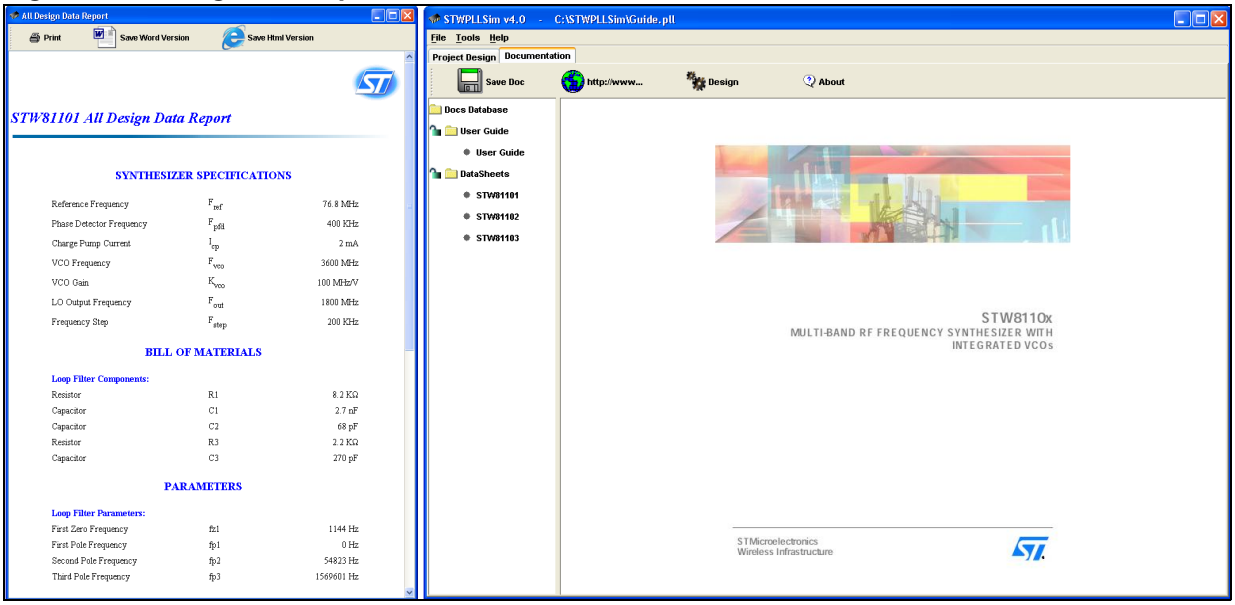


4 Report generation and documentation

A report containing the synthesizer specification, the bill of materials and the design parameters can be generated by the tool.

The documentation form contains datasheets and application notes.

Figure 10. Design data report and documentation form



5 Revision history

Table 1. Document revision history

Date	Revision	Changes
19-Jul-2007	1	Initial release.
20-Jul-2007	2	Corrected the numbering in *Figure 2: Main settings*.