

Switch Mode Power Supply (SMPS) Small Signal Design Development Tool

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PROJECT MOTIVATION

Many customers are not power supply development experts but require development of supplies for their systems. They often encounter difficulties when trying to find a solution that satisfies both performance and stability requirements. To aid their design activity, ON Semiconductor has previously provided design aids in the form of Microsoft Excel or MathCAD files which help them perform the necessary calculations. From these calculations, they can test out the recommended component values by either simulation or physical implementation. Both of these methods are often a difficult and time-consuming step for the customer, but they are necessary to verify the performance and stability of the design. It would be more efficient for the customers to have access to an executable file that can import the power supply system requirements and calculate the circuit and compensation component values that are necessary for their design. The tool should provide bode plots for small-signal verification.

KEY ACCOMPLISHMENTS

- **Software Design and Development:** Made UML class and activity diagrams for each fundamental part of the graphical user interface. The diagrams and the flowchart document the intended functionality of the user interface, incorporating all elements of the team's flowchart and all previously defined functional requirements and features of the graphical user interface.
- **Schematic:** Imported the schematic of the NCV891930 as a JPEG and PNG file into MATLAB and programmed text boxes for user entry in surrounding areas around every single component that should be able to be altered.
- **User Inputs and Text Boxes:** All of the text that is entered into the text boxes is selectable and able to be copied by the user. At the same time, the capability has been created to show recommended values for each component. Based on certain user entries, error messages,, help messages, and questions can be outputted to the user.
- **Multiple User Input Mechanisms:** Fully implemented the slider for user entry (and integrated it into the GUI using normalized units), including minimum and maximum parameters for the inputs. The slider moves to a specific position, which corresponds to the user entry that is inputted into the text box above it.
- **Bode Plots:** Implemented the various types of bode plots that are needed in the GUI. Enabled a cursor function that can be used to locate the position of everything on the bode plots. Using the cursor mode and keyboard commands, the clients of the design development tool can select multiple data points on the plot.
- **Dynamic Visual Representation of Data:** Implemented a display crossover frequency, phase margin, and gain margin above the bode plots. As the component values and other adjustable inputs are changed, the graph and the statistics will change.
- **Output Window:** Set up the entire window of graphs with options for tasks such as printing and saving when the user runs the program. The graphical user interface will sustain its high resolution settings, no matter what the size of the window is changed to.
- **Part Configuration Files:** A part configuration file was first developed using Microsoft Excel spreadsheets to contain all important parameters for the NCV891930 and NCV97400. These spreadsheets were then converted to CSV files to bypass licensing issues for users who do not own Microsoft Office.
- **MathCAD Conversion:** The sample MathCAD files used for the customer design process were converted to MATLAB scripts.
- **Support for SI Unit Prefixes:** By default, MATLAB does not support for prefixes such as milli, micro, nano, and pico. Conditional statements were added to convert user inputs that contain SI prefixes to a number format that MATLAB can interpret. This will make it easier to enter numbers with a large or small order of magnitude.
- **Power Dissipation/Efficiency:** Along with the required gain and phase calculations, many other equations were added to calculate the power dissipation of each component and the integrated circuit. These values are used to calculate the power efficiency overall.
- **Screen Resolution Compatibility:** All GUI components are defined in normalized units. In other words, the size of the text and buttons are a function of the window size. This makes the software package compatible with all screen resolutions.

ANTICIPATED BEST OUTCOME

The anticipated best outcome is a configurable tool suite with detailed documentation in the form of flowcharts and block diagrams. The tool will be used with ON Semiconductor DC/DC converters to perform the necessary system calculations and help with external component selection. Furthermore, the tool should be modular and versatile so that it can be adapted to all future products by simply importing a part configuration file for each new part. The most convenient form for the customer is an executable file that can be downloaded from the ON Semiconductor product webpage.

PROJECT OUTCOME

The Anticipated Best Outcome was achieved.

FIGURES

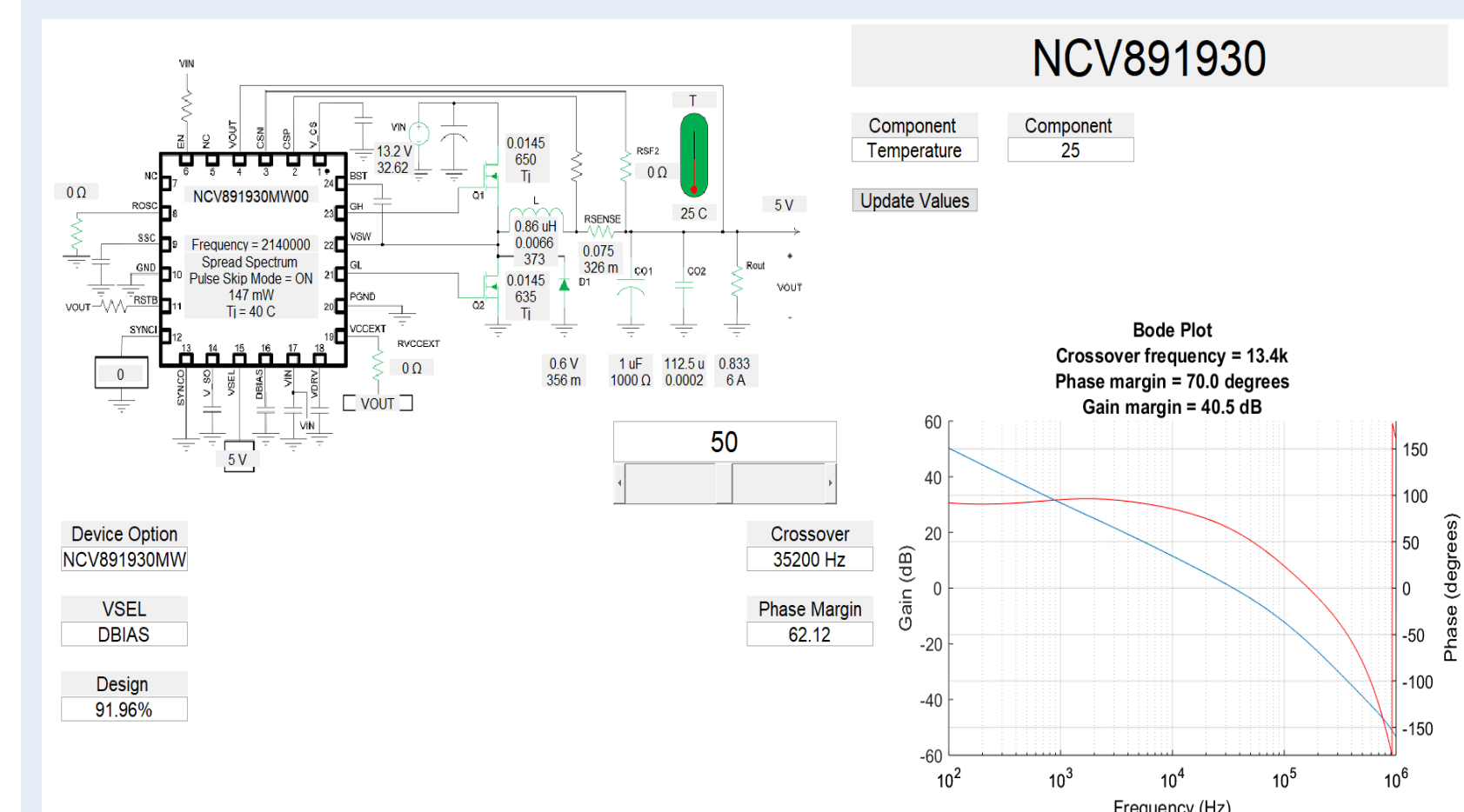


Fig. 1: The complete prototype of the Graphical User Interface.

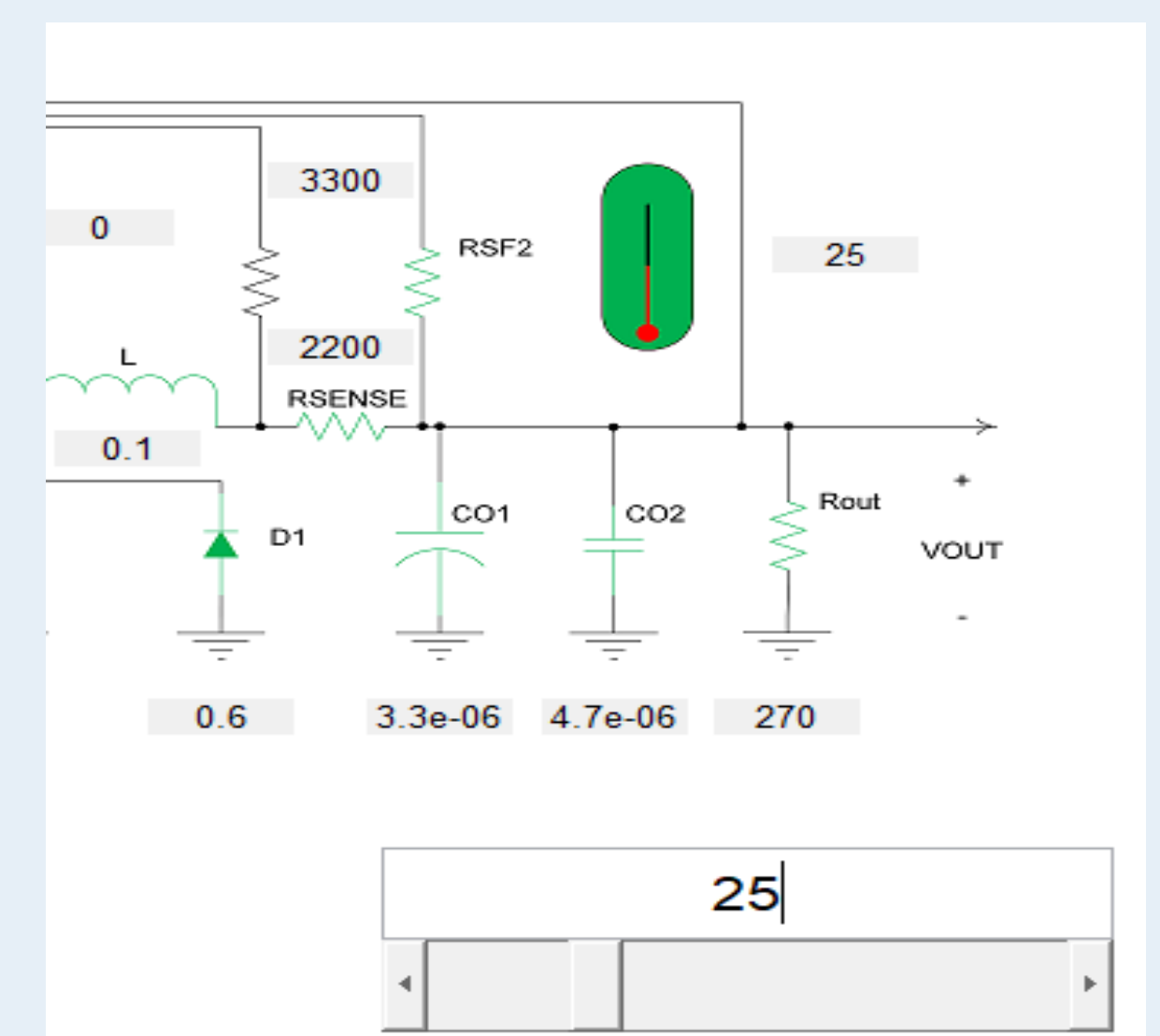


Fig. 2: The tool's slider which is utilized to change component values.

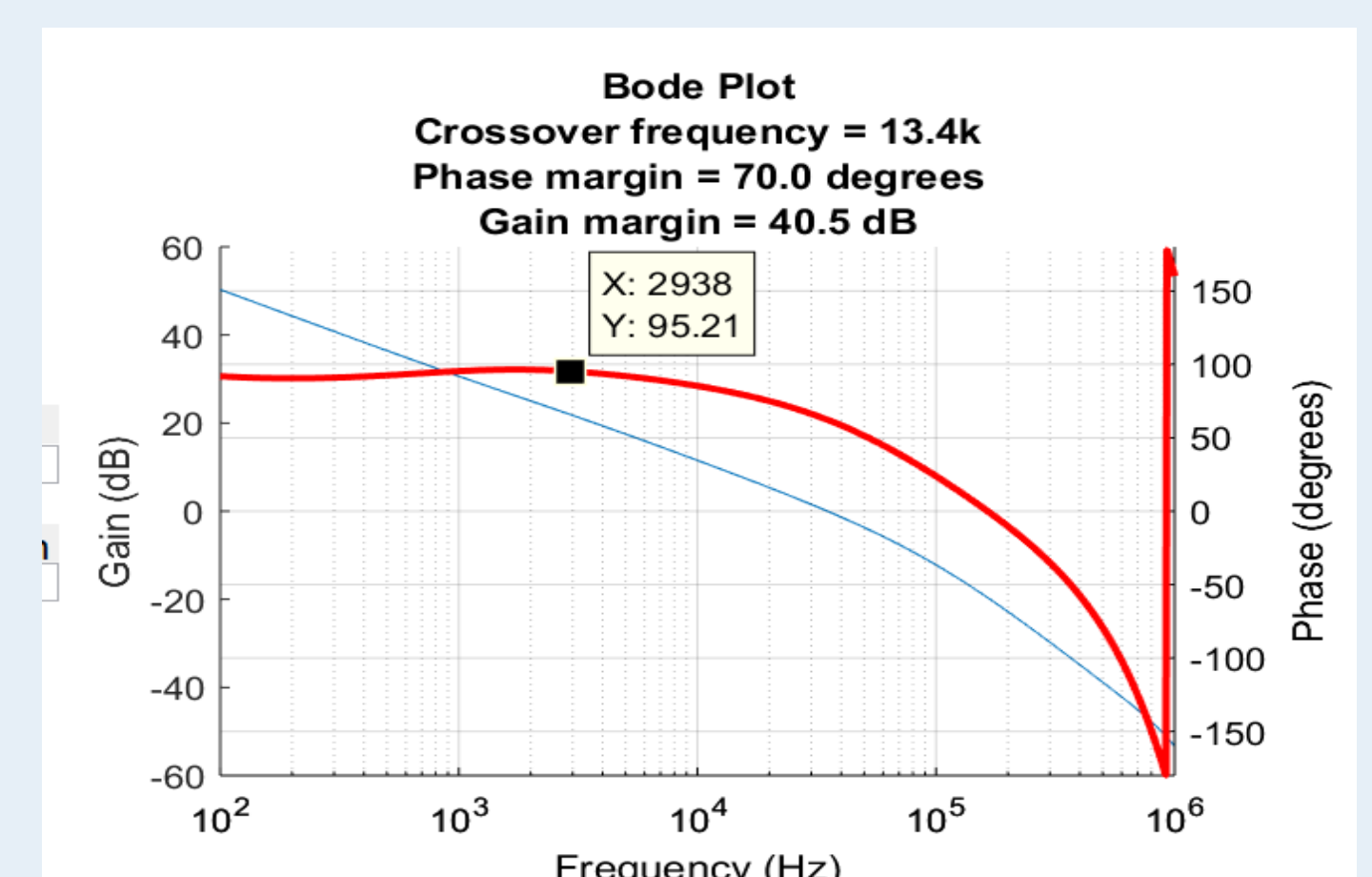


Fig 3: The tool has the capability to display bode plots with cursor functionality and relevant graphical information