



BY RON MANCINI

Compare Spice-model performance

I wanted to use Spice to predict the PSRR (power-supply-rejection-ratio) performance of an op amp. My plan was to evaluate the effects of adding decoupling capacitors or local power-supply filtering to improve the circuit's PSRR, but first I needed to establish a baseline-PSRR performance. I inserted an ac signal into the ground return to check the OPA132's PSRR performance, and the results were terrible; the plot indicated that the OPA132 has 8-dB PSRR capability. This op amp's data sheet indicates a PSRR of 100 dB at 90 Hz. Because of the

difference between the model and the data-sheet performance, I was sidetracked into looking at Spice models rather than improving PSRR.

I can't think of anything more objectionable than looking into the innards of software; thus, I enlisted the help of Neil Albaugh, an expert in analog circuits and Spice. Neil confirmed the poor PSRR performance of the OPA132 model, and he calmed my whining about the poor models with which design engineers have to work. He checked out the measurement circuit by analyzing an OPA227, and he received excellent PSRR performance. The semiconductor industry generated early Spice models by running PSpice Parts simulation software. This program generates a standard Boyle-op-amp model from extracted device parameters (Reference 1). The basic Boyle model does not model the following parameters: input-offset voltage and current; input current and voltage noise; input protection, impedance, or capacitance; output-current flow from the power supply; quiescent-current changes with power-supply-voltage or temperature changes; gain versus temperature; CMRR (common-mode rejection ratio) or PSRR versus fre-

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quency; and PSRR.

The enhanced-Boyle model follows the basic-Boyle model and adds the following parameters: input voltage and current noise, input capacitance and impedance, quiescent-current changes with power-supply voltage, and output-current flow from the power supply. These additions make the enhanced-Boyle model much more usable, but you can't do an in-depth analysis with these poor models.

The latest generation of macromodels is considerably better than their predecessors. The OPA227 performs excellently in the PSRR test; it is a late-generation model with the latest features. When you first get a model, try to open it with a text editor, such as Microsoft Wordpad, to see what the model contains. Older op-amp models may be Boyle or enhanced-Boyle models that have few features. A newer op amp, such

as the OPA301, has an improved model and opens with the statement "OPA301.MOD." The descriptive data within the OPA301 model reads: "Model temperature range is -40°C to $+125^{\circ}\text{C}$, not all parameters accurately track those of an actual OPA301 over the full temperature range but are as close as possible." This model offers 20 features, such as PSRR versus frequency, for this op amp. This scenario is still imperfect, but semiconductor manufacturers are coming close.

Reference 2 is a good source for older models. It gives the history of a company's experience with making macromodels, and it contains a wealth of useful information. The newer models contain descriptions that you can access. Knowing your model is a key to success when you use an analysis program. Coupling the model knowledge to model testing, correlating the model to the data sheet, and correlating the model to lab testing are the required series of events to ride the road to analysis success. **EDN**

REFERENCES

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