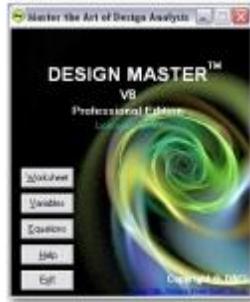


Design Master™: A Straightforward No-Nonsense Approach to Design Validation
by Ed Walker
[Design/Analysis Consultants, Inc.](#)



Our approach to design analysis is based on practical, meat-and-potatoes methods derived from more than twenty-five years of experience helping customers build products that work. One of the more helpful tools we've developed and used is probability-based risk assessment, a component of our Worst Case Analysis Plus™ (WCA+) design validation methodology.

WCA+ is very powerful, but there's a catch...it requires thinking. We happen to believe that thinking is a good thing, even a prerequisite for proper engineering. Unfortunately, many of you may have noticed that a lot of our peers spend their time pecking at computer terminals running simulations. Unfortunately, although this can be helpful in some cases, this is not engineering. Analysis is engineering, and analysis by definition requires thinking, not tinkering.

We discovered a long time ago that simulation tools were of very limited value when applied to analysis. This heresy was kept internal to our company, where we developed our own math-based software to help us analyze rather than simulate. The result was that as time went by and our math skills improved, we found ourselves using simulations a very small percent of the time; most of the time we sat and thought and analyzed, resulting in a very good understanding of the designs we were developing or evaluating for our customers.

Granted, employing math analysis was a heck of a lot more work than fiddling with component values in a simulation, but the professional payoff for this discipline was immense, both in meeting our customers' needs and in job satisfaction.

The bottom line: our customers were very pleased. We identified problems that had been missed by testing and simulations, problems that could have cost a bundle to fix downstream, problems that could have severely damaged profit margins, problems that could have resulted in fatal blows to our customers' reputations. From a personal satisfaction standpoint, it just felt good to know what was happening in a design, and to be able to help our customers in a very cost-effective manner.

Introducing Design Master™

As we developed our skills, we also developed our in-house software. After several years and many refinements, we made Design Master commercially available. Since we had to actually use the program on a continuing basis, we made it as easy to use as possible, while constantly refining and adding features. The result?

Design Master is as easy to use as a spreadsheet, but much more powerful and versatile.

With Design Master, you can answer the following critical questions:

- Will this design meet its specifications for the worst case combination of component tolerances and operating conditions?
- If not, what is its probability of failure?
- If not, what components or operating parameters have the greatest effect on performance, and how should I adjust them to correct or center the design?

The three questions above embody the heart of design validation. Will my design work? (Verify functional and stress margins; catch design defects before they get into production; identify problems that can easily be missed by testing and simulations.) Are detected design deficiencies significant? (Risk assessment, prevent costly overdesign.) How do I correct or center my design? (Design optimization for better yield.)

If you're saying, "how can I understand a complex design without using a simulator?" you're on the wrong design wavelength. If a design is so complex that you think you need a simulator, you're asking for trouble.

Successful designs are characterized by being elegant and thereby relatively easy to understand. As you develop your analysis skills, you will find that what initially appears to be a large complex design can often be broken into small manageable chunks for analysis.

Painless Probabilities

One of Design Master 's coolest features is its probability-estimating capability. This allows you to apply in a painless manner some of the powerful concepts that you dreaded to study in college.

With a conventional approach, such as Monte Carlo, IF you have an adequate sample size and IF the samples are independent and IF the samples are representative (and for simulators, IF you know the distributions of the variables) and IF you use proper calculations THEN you may obtain some very useful data. But if any of the above conditions are not true then you may get garbage. Having to fulfill these conditions is why so many of us avoid statistical methods, or misuse them when we do attempt to use them.

The Design Master approach is different. Design Master works from the outside in, rather than the inside out.

With a statistical approach, such as Monte Carlo, one is trying to infer the boundaries of performance from representative samples. This is a hazardous method for assuring design reliability, since one never knows for sure whether or not the boundaries of performance have been identified. Also, for most practical cases, the degree of reliability required for a design requires one heck of a lot of Monte Carlo trials, which provide a "confidence" level, not a certainty.

Creating Successful Designs

Using Design Master, however, one identifies the boundaries of performance, then obtains an estimate of how often performance will exceed specification limits. This is much safer and simpler. First you identify the worst case performance boundaries, so you don't have to infer anything. This is safe. Second, using conservative assumptions, you estimate how often the calculated results will exceed the specification limits. This is simpler.

Most important, if you find that a design is too large and intermingled to be understandable, you will change the design! After all, if you can't understand a design, how can you verify the validity of computer simulations? (If you're a manager, never accept computer simulation printouts as a substitute for analysis; if your designers really understand what they've done, they should be able to explain it to you in understandable algebra.)

Equations are available or can be developed for a myriad of applications, including parasitic effects and nonlinear responses; essentially anything you will need for an analysis. This means that you should be able to obtain or develop the set of equations that describes your design. Also, Design Master comes with several sample analysis and equation files for electronics applications. Downloadable files are also available.

Just Getting Started with Worst Case Analysis?

If you're just getting started with engineering analysis, and/or are tired of the seemingly never-ending hunt-and-peck process of using simulations, we suggest you read our *Design Analysis Handbook*, which Frank Goodenough of Electronic Design said is "...a book that should be on the shelf of every digital or analog electronic-system designer." The handbook is a practical guide to design validation, and will get you off to a good start.

