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A Picture is Worth a Thousand . . . *Equations*

Gary Breed
Editorial Director

At the recent IEEE International Microwave Symposium, I got into a discussion where someone asked, "With all the computer power at our disposal, why do we still use the Smith chart?" My first reply was, "Do you actually design with it; calculating the component values from the arcs on the graph paper?" Of course, the answer was, "No, I just use it to see what's happening." The summary of the discussion was that we really don't use the Smith chart in its full implementation, but it remains a powerful design aid.

The Smith chart's staying power demonstrates that a lot of information can be presented visually. The same can be said for almost any graph or instrument display—The shape of a waveform on an oscilloscope can tell us whether an amplifier is clipping, a spectrum analyzer display can show us harmonic and spurious responses at a glance, an eye diagram can quickly show the general signal-to-noise performance of a datacom system.

A significant number of engineers rely mainly on mathematics as they design. They are excellent engineers, with notebooks that are full of equations, with fewer sketches than their colleagues. I'm willing to bet that they don't realize how much they rely on visualization. Maybe they are just very good at visualizing things in their heads and don't need the "back of a napkin" for thinking assistance. I doodle constantly when working out a design problem. Even if I never look at those sketches again, they help me determine the parameters of the problem.

This discussion, as usual, has a connection to my role in publishing. We use a lot of photos, graphs and diagrams in *High Frequency Electronics,* and I always wish we had more. With so much technology to cover, we can't provide the same detail—including the necessary full set of equations—as a specialized "transactions" publication. Good visual content helps us get as much data as possible into the pages we have available.

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New Technologies and Engineering Trends

Here are a few notes on some things we've been watching. Some of these will be covered in future articles, while others are just part of the "market intelligence" that we continuously gather to stay abreast of the industry.

Fuels Cells—Your local newspaper's business pages may have included a story about NEC's new fuel cell-powered laptop computer. The company is promoting about 3 times longer operating time than with conventional batteries, which is a major step forward. Fuel cell technology will probably play a significant role in future portable energy delivery, since it is both refillable and provides a lot of energy per unit weight. The main drawback I see is that the fuel cells are hydrocarbon based—it's possible that they may fall into the same category as butane cigarette lighters, which are banned from airplanes. While the use of hydrogen and hydrocarbons raises concerns for safety, I think some imaginative chemical engineer will find a solution.

UWB—We are also watching the early development of ultra wideband (UWB) technology, which is slowly working its way through the development labs at data communications companies. The engineering community is still very low on the learning curve, and we are planning coverage of UWB in the near future.

mm-waves—We think millimeter-waves will be a fertile area for new product development before very long. The first "high volume" applications will probably be in realm of sensors, with industrial process control a logical place for early commercial applications.

Transportation—Automotive electronics' use of wireless and optical technology has been widely reported and appears to be a legitimate "killer app" for a handful of companies.

Internet access—Wireless high speed Internet access has had a few false starts, but must still be considered a viable large-scale application as the demand for bandwidth grows. The main questions revolve around the type of network structure and which frequency bands provide the right combination of availability, performance and cost.

DAB and DTV—Finally, I wonder what's going to happen with digital broadcasting, both radio and television. The need to update 60 to 100 year old technology seems obvious to me, but change happens slowly in well-established industries like broadcasting.

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