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SUMMIT
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Classic Design, Implemented with New Materials

Gary Breed
Editorial Director

My wife and I recently moved into a new, energy-efficient home. Visually, we designed it to be quite traditional, with no obvious experimental or avante garde features. Structurally, we built it with attention to current technology, including a few construction practices that have been around for many years, but are only now starting to become common.

The foundation and main floor walls use insulated concrete form (ICF) construction, all windows and doors have low-E glass and minimal air leakage, and special attention was given to insulation. The non-ICF exterior walls and attic are insulated with a combination of sprayed-on foam to prevent air infiltration and economical dense-packed cellulose to achieve a high R-value. Even the basement floor is insulated with an inch of high density foam board under the concrete. Along with the use of high efficiency heating and cooling equipment, these features earned us Energy Star certification, significantly exceeding most of that program's energy efficiency criteria.

Sure, I enjoy discussing my new house, but what does it have to do with electronic technology? Well, the building process has some parallels to the evolution of circuit design. One part of that evolution is described in our featured article by Ain Rehman about microstrip design on silicon substrates. The building techniques we used for our house are not really new, and neither are microstrip and silicon ICs. They have been around for many years, but—also like construction of an energy-efficient home—the combination of technologies and application of recently acquired knowledge is what's important. New methods are required to meet the need for higher performance with these established designs.

Circuits are getting smaller, and the design engineer's job is changing accordingly. But a circuit is still a circuit, and distributed elements are still transmission line segments. What has changed is mainly the materials needed to support the fabrication of smaller devices, which must be smaller because of the shorter wavelengths at higher frequencies, as well as the demand for miniaturization at all frequencies.

Silicon is an attractive substrate material for several obvious reasons: it is already an IC with active devices, it allows high volume automated

fabrication, and it is inexpensive with well-established processes. The main drawback is that it is not a very good high frequency substrate unless modifications are applied. This is where the information in Mr. Rehman's article becomes important.

Adapting Si for microwave applications can be done more than one way, but all of them involve establishing a metal layer (ground plane) and adding a layer of SiO_2 (glass) to improve the loss versus silicon alone. This issue's article emphasizes an analysis of the process options for microstrip on silicon. We will have another article on this subject in the next issue, which will have greater emphasis on circuit design matters.

This is not the only area of current development that applies new knowledge to established technologies. This issue also includes a review of current and developing microwave sensor technologies. Many of these have been around for a long time, but are getting renewed attention for wide-area and large-scale use using wireless networking.

MIMO (multiple input/multiple output) techniques have recently received much attention in university research and practical applications. Of course, steerable phased arrays and diversity techniques have been around for decades, but MIMO adds the newly acquired knowledge of engineers working with cellular networks. Our June issue will have coverage of this important technology, which will soon be widely used.

We constantly follow developments in these and other technologies, presenting both general articles that introduce new ideas, and technical articles that explore those ideas in depth. Is there something important we should be covering? Your suggestions and feedback are always welcome.

New developments in high frequency technology are yielding the same kind of improved performance and lower costs seen in an energy efficient home.

We are nearing the end of the heating season and will be analyzing our energy consumption versus heating degree days. So far, based on our electricity and propane usage, it looks good. And the new house is more comfortable than any of our previous homes. The excellent insulation, plus the mass of concrete and exterior brick, really slows down the rate of heat flow. We're saving energy and staying warmer at the same time.

That's how progress is supposed to work!

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