

A Question on Microwave Propagation

Editor:

Since your editorial calendar shows “Signal Propagation” as the tutorial subject, I’ll submit this question for the September issue. I know that rain and trees affect Ku band satellite signals, but I’d like to know how much effect there is, and how it changes at different frequencies. Specifically, is it a lot in the 5 GHz ISM band, or does it show up only at higher frequencies?

Rod Parks

Notes on Microwave Absorption

Rod:

Fortunately, there is plenty of data available on this topic, although it is not included in some recent books on wireless communications. I expect it to be re-discovered as commercial wireless applications reach higher microwave frequencies!

My reference is a graph originally presented at the CCIR XIIIth Plenary Assembly, Vol. V, Report 233-3, Geneva 1974. With rain falling at 30 mm/hour (just over one inch per hour), the attenuation due to precipitation at 5 GHz is just 0.07 dB/km. So the answer to your question is, “No, there isn’t much effect at 5 GHz.” However, at 30 GHz, where LMDS is being developed, attenuation is nearly 7 dB/km. The amount of attenuation due to rainfall increases rapidly above 5 GHz.

Vegetation contains moisture, so its effect is proportional to these atmospheric numbers, but there are many variables with regard to season and type of vegetation. Dense forest will obviously have more attenuation than a single maple tree.

Complicating the effect is the absorption from other components of the atmosphere. Besides rain, there is gaseous water vapor and other atmospheric gases. Most of these do not have significant absorption below 10 GHz, but must be considered for systems above that frequency, especially into the mm-wave range.

Gary Breed
Editorial Director

Microstrip Etching Accuracy?

At the risk of sounding ignorant (which I am on this subject), I’d like a quick summary of the issues in accuracy of etching printed circuit boards with microstrip lines on them. I am just beginning to work with these circuits in our engineering lab and have read up on the subject, but a sanity check would be good to see if I am on the right track. Thanks!

“Mike” (at a major defense contractor)

P.C. Board Etching Issues

There is no need to remain anonymous, but we’ll help with your question. The main accuracy factors in printed circuit board line accuracy are:

Basic photolithography—This is not much of an issue; the “master” for board etching will be precise.

Resist “spreading”—This is only slightly more important, since board houses have refined their process for depositing the resist onto the copper. [We have a similar issue in printing—press masters must allow for the spread of ink on the paper—ed.]

Undercutting from the edge of the resist layer—This used to be a big deal before the thickness of the copper layer was precisely controlled, or when the chemical etchant was getting old and boards were left in the bath for longer times. Some design software artwork output includes allowance for undercutting, so be sure the board maker doesn’t also compensate for this effect.

Other issues are with the board material itself, including accuracy and consistent manufacturing tolerances for the dielectric constant and board thickness, temperature- and humidity-related changes, or other physical and chemical factors. The major microwave board manufacturers are good sources for additional information. Here are the URLs for some of the best-known companies:

- Arlon – www.arlonmed.com
- GIL Technologies – www.gilam.com
- Park/Nelco – www.parknelco.com
- Polyflon – www.polyflon.com
- Rogers – www.rogerscorporation.com
- Taconic – www.taconic-add.com

Our “Ask the Experts” column is published in each issue of High Frequency Electronics. Send us your questions and we will do our best to find someone to provide an answer; find the answer in the literature, or collect data from several sources that sheds light on the topic.

Questions and comments should be sent by e-mail to: editor@highfrequencyelectronics.com, by fax to 608-845-3976, or by mail to: Editor, High Frequency Electronics, 6666 Odana Road – #508, Madison, WI 53719.

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