ARLON Materials for Electronics

High Tech News

Engineered Solutions for Advanced PWB Technology

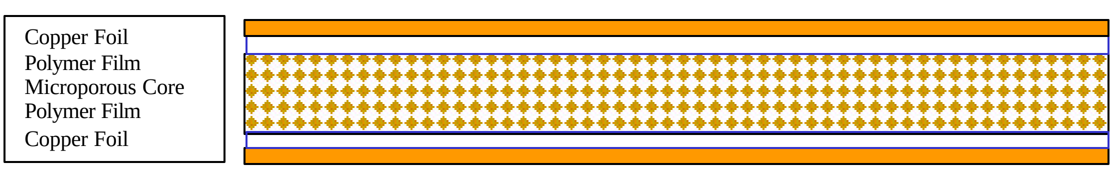
Volume 2004, Number 1 June 2004

In this Edition:

Novel Arlon Foam Clad Antenna Laminate Receives US Patent

Rancho Cucamonga, CA -- On March 9, 2004 US Patent 6,703,114 was issued to Arlon Materials for Electronics covering the design of Arlon's FoamClad$^{R/F}$ "etch ready" antenna material. FoamClad$^{R/F}$ 100, the first in a planned series of FoamClad$^{R/F}$ products, offers the antenna designer a combination of very low dielectric constant (1.15 to 1.35) and loss (0.002 to 0.005), light weight and significant cost savings over the use of traditional materials. In addition this unique design results in very low values of Passive Intermodulation Distortion, typically below -155 dBc.

FoamClad$^{R/F}$ 100 is a novel family of laminate composites consisting of a low permittivity microporous polymeric core bonded to an impermeable copper-clad polymer film coverlay that provides a low composite dielectric constant. FoamClad$^{R/F}$ **100** is a conveniently processable material for the manufacture of low cost, lightweight printed circuit antennas for cellular infrastructure, automotive radar and other microwave and R/F applications. The patented design of this product makes it "etch ready" out of the box, which augments its already low material cost in permitting the design of low cost, easy to manufacture antennas for a variety of applications.



FoamClad$^{R/F}$ 100 is available in 24" width and lengths from 12" to 120". The products are available either double clad (copper both sides) or as single sided configuration with pressure sensitive adhesive and a polymeric release film on the opposite side. Nominal base thicknesses available are: 0.040", 0.072" and 0.096" for double-sided Cu laminate, and 0.036", 0.068", and 0.092" for single-sided Cu laminate. (Nominal dielectric thicknesses do not include copper or release sheet.)

Additional product offerings in thicknesses based on 0.125", 0.187" and 0.250" microporous foam core thicknesses are under development and are expected to be released during the second quarter of 2004 to further broaden the applicability of the FoamCladR/F line.

For additional technical or pricing information and to get samples of the material for evaluation in your application, contact Arlon Microwave Products Customer Service at 1-800-635-9333.

FoamClad$^{R/F}$ is a registered tradename of Arlon Materials for Electronics, Bear, DE

Arlon to Open Suzhou, China Finishing Center

On June 29th, Arlon officially opened its new Finishing Center in China. Located in Suzhou's New District, the opening ceremony will mark an important step in establishing a local presence to satisfy the requirements of ARLON's growing Asian customer base. The event, which was hosted by the facility's manage Watt Wong, was attended by local dignitaries, industry press, customers, and other ARLON executives.

From the Finishing Center, ARLON will provide customer specific panel size and format requirements through dedicated fabrication, packaging, and quick turn capability. Product availability through the finishing center will include a range of ARLON's advanced laminate and prepreg materials including PTFE based laminates, low loss thermoset materials, as well as polyimide, Thermount, epoxy no flow, and thermally conductive laminate and prepreg products. Local customers will be able order select products directly from ARLON's Suzhou facility. This will enable quick and efficient support to local PCB shops and OEM's as well as global board shops and OEM's with operations in Asia.

Our New Address and Phone Number in China:

Arlon Materials for Electronics Co., Ltd.
Building 7, Da Xing Industrial Park of Suzhou New & Hi-tech District
Jiangsu, China, 215000

Tel: 86-512-66721698

Arlon Announces NAN YA Distribution Agreement

ARLON Materials for Electronics has entered an agreement with the Electronic Materials Division of NAN YA Plastics Corporation, whereby ARLON will distribute NAN YA laminate and prepreg products in North America.

The product lines of ARLON and NAN YA are complementary, and together, the two companies will provide North American PCB manufacturers the most advanced and most complete line of high quality substrate materials.

Under the agreement, ARLON will offer the full line of NAN YA substrates, including NAN YA's 170^{o}C Tg epoxy thin core laminate and prepregs for multi-layer applications. ARLON will provide customer specific panel size and format requirements through dedicated fabrication, packaging, and quick turn capability.

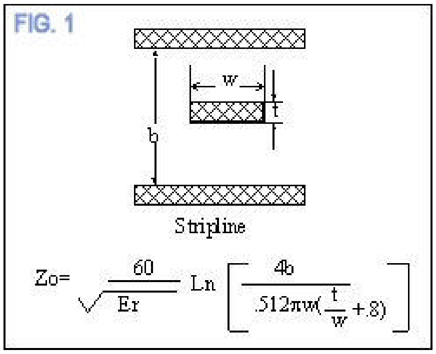
Bob Carini, president of ARLON said, “We are excited to form this strategic alliance with NAN YA. The addition of the NAN YA products to our existing materials offering will allow ARLON to provide its North American customer base the complete range of substrate products for all applications.”

According to NAN YA's Electronic Division's Taipei office, this new relationship with ARLON means our full range of high quality, technology leading laminate and prepreg materials will be more readily available to North American circuit board manufacturers. This will be done through ARLON's established manufacturing, sales, customer service, and technical support infrastructure. Further, ARLON's OEM focus will enhance our sales potential in Asia and other markets around the world.

Characteristic Impedance and the Dielectric Constant Trap

The standard formula for Characteristic Impedance (Zo) as shown in Figure 1, below, depends on the geometry of the system and the relative dielectric constant of the material of which the multilayer board is constructed. The geometry is relatively simple and involves the dimensions of the etched copper transmission line whose impedance is being measured. The equation assumes that the etched transmission line is square in cross-section, and if this is not true distorted results may occur. This example illustrates a symmetric stripline where the distance from the transmission line to either ground plane is the same. The math varies slightly for an asymmetric stripline or for a surface microstrip, but the basic principles are the same. I selected stripline because the dielectric constant “Trap” can be greater in this than in the other configurations. So what do I mean by a “dielectric constant trap?”

FIG. 1

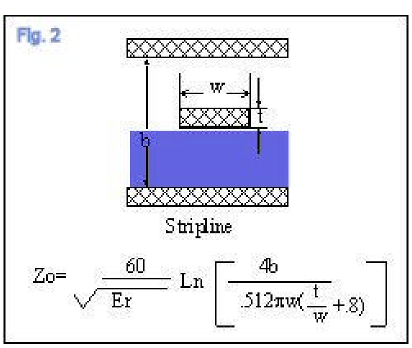


When you look at the equation for impedance in a stripline you see that the impedance is roughly proportional to the inverse square root of the dielectric constant. This is the "trap" because most people use as a value for dielectric constant, the published (data sheet) value for Er of the laminate they use to make their MLB and almost without exception that will result in theoretical impedance numbers that won't match with the results you get when you actually fabricate the boards and test them. And before you get on the phone and castigate your laminate supplier for providing "erroneous data," let me give you two reasons why the data as supplied is correct and yet might not be giving you the right results.

First, most of the dielectric constant data that has been amassed over the past 15 years or so for conventional laminates has been generated at 1 MHz using a two fluid cell methodology because that's what the military, and now IPC, specification baseline has been standardized around. Dielectric constant, unfortunately, is not a "constant" in the sense that most of us understand the term for things like the speed of light in a vacuum or Planck's Constant. The reason the term for dielectric constant in most equations is shown as Er is that it stands for "Relative Dielectric Constant" and when you start looking at it closely, it is "relative" to several things, including test method, test frequency, test temperature and sometimes I think the phase of the moon. So unless you happen to be using the material at the same frequency at which it was tested and the same temperature at which the test was run, significant differences are likely to exist. Just that you are making a MLB of a certain configuration also means that you will be testing differently as well. In general, the relative dielectric constant of conventional laminate materials such as FR-4 or polyimide-glass will go down as frequency is increased. As an example a polyimide glass laminate whose Er at 1 MHz is 4.4 may be 4.2 or less in the range of 1-2 GHz where so much work is being done these days.

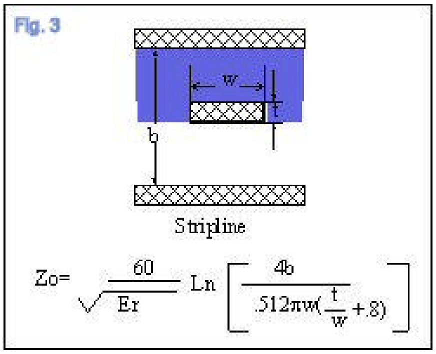
That's only the first part of the story, because the published value of the Er will not be the same as the Er of the finished MLB, and again there is more than one reason why this is true. First and most important the published Er value on a data sheet is usually based on a standard laminate thickness and construction. Let's say that we use an 8 core laminate with a core construction whose dielectric constant (determined by the volumetric ratio of glass to resin) is 4.2.

Fig. 2

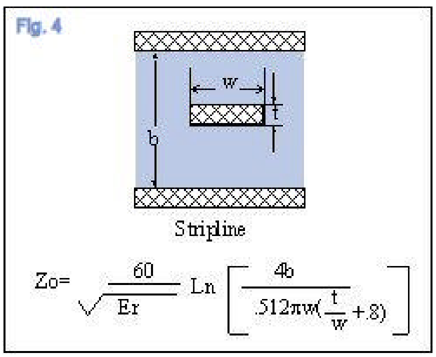


In this figure (Figure 2) the dark blue area is the part of the system surrounding the etched stripline whose dielectric constant is 4.2. As you see, the other three sides of the etched line are not necessarily of the same dielectric constant. They are encapsulated with resin from prepreg, whose resin content is usually much higher than that of the base laminate and therefore their effective dielectric constant is measurably lower.

Let's say for argument's sake that they average somewhere around an Er of 3.8.



The next diagram (Figure 3) shows the area in dark blue that is surrounded by the high resin content prepreg and has a substantially lower dielectric constant than that of the laminate itself. In fact the two edges of the transmission line are essentially embedded in pure resin whose dielectric constant is closer to 3.2, although the area above the line has lightweight glass, so as an average we might have a net value of about 3.8.



In the final diagram (Figure 4) the light blue area shows the area whose **average** Er must be estimated in order to calculate an accurate value of dielectric constant for the impedance calculation. As this is a symmetric stripline the areas on top and bottom are about equal and we can use a simple average value for dielectric constant, in this case 4.0, which will be a good starting value for most polyimide multilayer boards with buried stripline.

The difference in this instance results in a shift upward of impedance by about 2%, not in itself a serious issue. But suppose instead that you had estimated Er based on published values for rigid laminate, whose value might be 4.6. Now the shift between your actual results and those you calculated would be even greater, about 6% -- in some cases this is as much as the tolerance allowed for the job. And that doesn't account for variations in laminate, thickness, etch tolerances and even finished copper thickness after processing and plating, all of which must be estimated for insertion into the equation for impedance.

As you can see, it is important to understand how dielectric constant can be estimated for each configuration you use. Your laminator can help you understand the dielectric properties of their laminates and prepregs to help you make better estimates for your own use. Many fabricators have established some working values for their boards for each type of material they use, although as in all things as complex as the impedance testing of multilayer PWB's, there is still some "Kentucky windage" both in design and process that has to be accounted for in the tolerancing of the job.

Meet Arlon People -- Christophe Allamando

Arlon is pleased to announce that M. Christophe Allamando of Tours, France, has joined Arlon in the position of Technical Sales and Service Engineer, Southern Europe. In this position Christophe will cover France, Spain, Italy, Germany and Austria, working both directly with OEM's and also with our distributors covering those areas.

Christophe holds a degree in Electronics and Microwave Application (1993, University of Lille, France) and is currently in the process of completing work on his MBA (2004, IAE Business school of Tours). He has worked for 8 years as a microwave engineer including as Manager of Microwave and Systems Division, ETSA, France and also as R&D Manager for Delta OHM.

In his new position Christophe will report to Ron Kirby, Director of Marketing and Sales, Europe.

Some Final Observations

Your Editor has been officially "retired" now for three months (and acting as a technical consultant to Arlon on a "telecommuting" basis). It's given me time to think, to get out and exercise more consistently and to start catching up on a lot of non-technical reading that I've been promising myself (for all of about 25 years) that I would get at "someday." If I didn't think it might cause a wholesale retirement of long-term employees in an industry where we are already short of good and experienced people I would take more time here to tell you how really great retirement is even after such a short time.

As I stand back a vast distance in time and space and look over a career in this industry that spans nearly 25 years, all of it spent with Arlon, I have to say that in deference to the obvious financial benefit of having been continuously employed by a good company for a long time -- it provided me with a living, put my boys through school, etc. -- the thing I will miss most won't be the salary or the work (trust me on that) but the people. This industry contains a treasury of really good people, and while this may not be my last newsletter, I want to take this opportunity to salute the many fine individuals I have had the privilege of working with over the past 25 years. I have worked closely with many of you both here in the States and around the world, in good times and tough times, in dealing with problems and in introducing new products and technologies. I have been around long enough to see many of the "good ones" retire, and to follow them into that golden land "flowing with milk and honey" as it were, and I want to urge that those of you who remain continue to provide the industry with the common sense energy, and enthusiasm that have made my life as a part of it so interesting for so long.

Space, and the risk that I would miss somebody and terminally embarrass myself, preclude my trying to make a list of the individuals who have become friends as well as colleagues: so to you all, my thanks for a career filled with professional challenge and great personal satisfaction.

Chet Guiles