More Information Needed on Echo Distortion

Reading the article, "Echo Distortion in Bandpass Filters" after having read the editorial [in the January 2003 issue] brought to mind an issue that needs to be addressed. With the diversity of background among your readers, the need for clarification and/or definition of terminology becomes even greater.

As a minor case in point, I have never heard the term "echo distortion" in my 25 years in the microwave industry. I think it might be passband ripple due to multiple mismatches. The term is rather descriptive but should be clearly defined.

Otherwise, it was another good issue of a useful magazine.

Evan M Kurtz
Syracuse Research Corporation

Additional Background from the Author

The term "echo distortion" originated in Medhurst's classic paper that is reference [1] in the article. In the 1956 to 1959 time frame, I was involved in the design/development of duplexers, bandpass filters, and mixer used in a multi-hop 2 GHz terrestrial microwave radio relay system. Echo distortion in long transmission lines between the common antenna and duplexer was a significant factor in communication system engineering. With broadcast video, echo distortion between receiver and antenna mismatches result in aberrations on the TV screen often referred to as ghosts. In the Second Edition of *IEEE Standard Dictionary of Electrical and Electronics Terms*, this has been referred to this as "echo attenuation (data transmission)."

Some satellite communications earth station equipment use multi-resonator bandpass filters that can also cause echo distortion in the usable filter passband. This phenomena has probably existed for over twenty years. Other engineers and technicians have probably noticed this source of transmission degradation. Because it is a somewhat obscure topic, no one seems to have written about it in a published article.

I am certain that the concept applies to other systems as well, however, the impact of this distortion on specific communications requirements was not within the scope of the article.

Richard M. Kurzrok
RMK Consultants

Notes from the Editorial Director

Mr. Kurtz is correct that the term is descriptive, and Mr. Kurzrok points out the slightly different terminology used for the same phenomena in different applications. Some 20 years ago, I was involved in troubleshooting excess reflections in a television transmitting system. Distinct ghosts were being produced due to discontinuities in the complex of connectors and elbows at the feedpoint of the antenna, which was located 1200 feet above the transmitter, at the end of 1500 feet of rigid coaxial line. At that time, I had not heard a specific term for such behavior in the context of television transmission, but I knew about "echo cancellation" as a means of correcting "echo distortion" problems in microwave and satellite systems.

Gary Breed
Editorial Director

A Question on Microstrip Construction

I am a fourth year student in Electronic Engineering in Israel. My project is to design a three-section directional coupler. I can't find anywhere how to calculate the connections between the sections. I have identified the methods for determining the coupling and dimensions of the three sections, but I don't know how to connect them.

Thank you in advance,

Ehud Lifshin

...and the Answer

The answer is simple, but not necessarily obvious: The widths are simply changed in a "step function" at the junctions between each of the three different line sections. This is not obvious, especially to a beginner, because we are also instructed to avoid using such discontinuities in other circumstances, such as a bend in a line with a continuous characteristic impedance.

Perhaps it is easier to visualize the lines on a more "macro" scale with coaxial cable sections instead of microstrip. In this case, each section of cable would simply be joined to the next section of cable without any intervening transition.

A quick literature search showed some work on tapered lines and other coupling structures without discontinuities, but the classic multi-section stepped-line coupler provides a level of performance that rarely requires further investigation.

Also, the stepped-line technique generally applies to multi-section impedance matching networks, although this is an area where significant work has been done on tapered lines to maintain optimal VSWR performance over wide bandwidths.

What's your question? E-mail it to us at: editor@highfrequencyelectronics.com

We will find an expert to provide the answer. And don't worry, we will e-mail you the reply so you don't need to wait for the next issue to arrive!