TN 96 -
How Low Temperature Co-Fired Ceramics (LTCC) transformers are used in analog modem applications:

TechNote

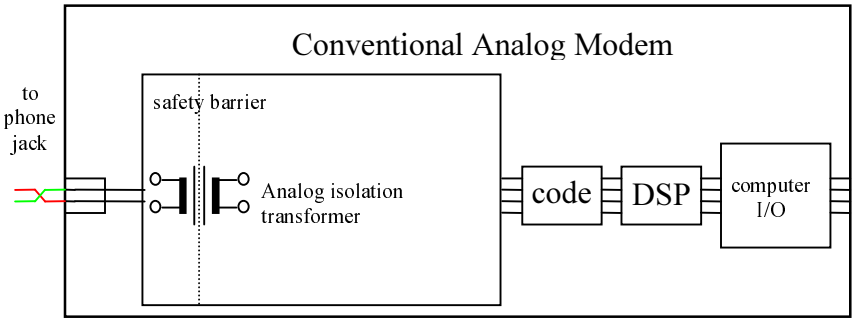
By Rick Stadtlander, Midcom, Inc. August 1, 2001

Introduction

This paper explains how MicroMagnetic transformers can be used to replace standard analog modem transformers and aid in the powering of line side IC's across the dielectric barrier.

History

In the past, analog modems have all used standard transformers that passed the analog modem signal across the dielectric barrier. This method used only passive components like resistors, capacitors and inductors on the line side. Therefore, no power was required either.



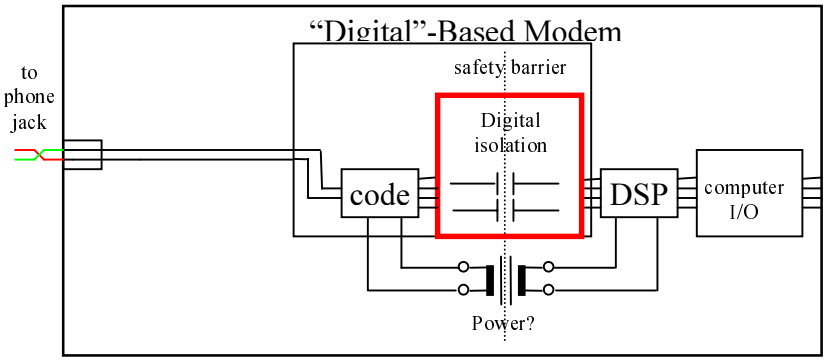
However, with the push to reduce size and cost, modem IC manufacturers have now redesigned their IC's to bring the analog signal directly into the CODEC, before it crosses the dielectric barrier. This has brought about the need for power on the line side of the dielectric barrier.

With the signal going directly into the CODEC, before it crosses the dielectric barrier, a standard modem transformer is no longer necessary. The signal is analog in nature up to the point that it enters the CODEC. At that point it is used to modulate a high frequency carrier or is converted into a digital signal, one that the computer can understand. Then the signal (usually into the 1-10MHz range) is transmitted across the dielectric barrier. At this frequency, the signal can be passed across the barrier using low cost (at least compared to a standard analog transformer) capacitors.

Midcom,Inc
121 Airport Drive
PO Box 1330
Watertown, SD 57201-6330 USA
www.midcom-inc.com
e-mail: sales@midcom-inc.com
Toll Free (US & Canada)
800.643.2661
Phone 605.886.4385
Fax 605.886.4486
Midcom, Inc.
10/F Spectrum Tower
53 Hung To road
Kwun Tong, Kowloon, HK
Phone: 852.2320.4221
Fax: 852.2352.3272
e-mail: gforsberg@midcom-inc.com

TN 96 -
How Low Temperature Co-Fired Ceramics (LTCC) transformers are used in analog modem applications:

TechNote



You now know how the signal gets across the dielectric barrier, however I mentioned power before, so where does that come into play?

The line side CODEC is an active device, meaning that it needs power in order to operate. There are a couple of ways to get this power to the CODEC: pull power off the phone line or pass power across the barrier using a separate transformer.

Pulling power off the phone line is not a very stable answer. The phone company doesn't like to do double duty as a power company as well. So they have reduced the amount of current that can be pulled off the phone line to discourage companies from continuing this practice.

Passing power across the dielectric barrier using a separate transformer is the most stable option. The amount of power that can be transferred is only dependent on the conductor and the size of the core. The transformer can also do double duty to pass the clock signal to keep the CODEC and the DSP in sync.

Replacement

Now, how can the MicroMagnetic transformer be used to replace a standard analog transformer and help power the circuit?

MicroMagnetic transformers are essentially no different from a standard wire wound transformer. The main difference is in the design and construction of them. The overall function is the same. To replace a wire wound power transformer with one of these devices is simply a matter of designing the MicroMagnetic transformer to have similar characteristics as that of the wire wound transformer. The main differentiators of MicroMagentic transformers are: repeatable in production and more cost effective production methods.

Current high frequency wire wound transformers utilize a toroidal core. The wire is pulled through the center of the toroid and wound around to form the turns of the transformer. This is usually done manually in an offshore production facility. Any process that is performed manually has some inherent variation to it. This variation can cause differences in the performance of the transformer from unit to unit.

The MicroMagnetic transformers are built using an automated process. This provides excellent

Midcom,Inc
121 Airport Drive
PO Box 1330
Watertown, SD 57201-6330 USA
www.midcom-inc.com
e-mail: sales@midcom-inc.com
Toll Free (US & Canada)
800.643.2661
Phone 605.886.4385
Fax 605.886.4486
Midcom, Inc.
10/F Spectrum Tower
53 Hung To road
Kwun Tong, Kowloon, HK
Phone: 852.2320.4221
Fax: 852.2352.3272
e-mail: gforsberg@midcom-inc.com

TN 96 -
How Low Temperature Co-Fired Ceramics (LTCC) transformers are used in analog modem applications:

repeatability from unit to unit and from lot to lot, ensuring that the transformer built in full production will be the same as the transformer originally tested in the prototype stage.

The strength of MicroMagnetic transformers is their size and cost. No other transformer has been built as small. The form factor easily adjustable to meet special requirements. If height is a critical component of a customer's design, then this is the only technology that can meet those stringent requirements.

Currently, MicroMagnetic transformers can handle continuous power up to 500mW. This is plenty for the modem applications being discussed in this paper and this level continues to increase.

That covers the power side, now how about the signal capacitors that some applications use?

The capacitors that are used to pass the signal across the barrier are special high dielectric capacitors that must have safety agency approval. They are much more expensive than standard capacitors, but much less expensive than a standard modem transformer.

These capacitors work well enough for passing the signal, but they are susceptible to allowing common mode noise to pass across the barrier as well. Transformers are very good at rejecting this noise; they have what is called longitudinal balance. The better the balance, the less noise that is transmitted across the barrier.

This noise hasn't been an issue for capacitors until recently due to EN55022 coming into effect soon. This standard requires that a certain amount of this noise be rejected, because not only will capacitors pass this noise across the barrier, but some of that noise could cause problems to the central office. Capacitor circuits can reject this noise, but it requires the use of external components to accomplish it, whereas a transformer can do it without those extra components.

This is where the MicroMagnetic transformer would be a benefit. Since it is able to operate at these higher frequencies, 1-10MHz, it can fit right into the function of the capacitor while providing good rejection of the noise signal. Some modifications of the circuit or IC may be required to fully utilize the transformer in place of the capacitor.

Midcom,Inc
121 Airport Drive
PO Box 1330
Watertown, SD 57201-6330 USA
www.midcom-inc.com
e-mail: sales@midcom-inc.com
Toll Free (US & Canada)
800.643.2661
Phone 605.886.4385
Fax 605.886.4486
Midcom, Inc.
10/F Spectrum Tower
53 Hung To road
Kwun Tong, Kowloon, HK
Phone: 852.2320.4221
Fax: 852.2352.3272
e-mail: gforsberg@midcom-inc.com

TN 96 -
How Low Temperature Co-Fired Ceramics (LTCC) transformers are used in analog modem applications:

Conclusion

MicropMagnetic transformers are very good at transferring power across the dielectric barrier. Although they do not directly replace a standard analog modem transformer, when used with new modem IC's MicroMagnetic transformers can be used to replace hand wound toroids. They are especially useful in applications where low height components are needed.

With common mode noise being a concern in industry, the transformer is a natural solution in the signal path. MicroMagnetic transformers can operate in the required frequency range and are able to filter off the common mode noise like any other transformer. Thus, providing a low height, cost effective solution to replace capacitors in the signal path.

Sales questions:
Daryl Schofield
Midcom, Inc.

phone: 605-882-0357

Midcom,Inc
121 Airport Drive
PO Box 1330
Watertown, SD 57201-6330 USA
www.midcom-inc.com
e-mail: sales@midcom-inc.com
Toll Free (US & Canada)
800.643.2661
Phone 605.886.4385
Fax 605.886.4486
Midcom, Inc.
10/F Spectrum Tower
53 Hung To road
Kwun Tong, Kowloon, HK
Phone: 852.2320.4221
Fax: 852.2352.3272
e-mail: gforsberg@midcom-inc.com