molex
one company > a world of innovation

DUPONT
The miracles of science™

DuPont Collaborates with Molex on New High Speed Flexible Interconnects

Provides system designers with lower loss flexible circuits and interconnects to achieve the desired high speed signal performance required in today's electronic equipment

This bulletin will highlight a new interconnect option that enables significantly higher frequency / speed performance for flexible circuitry. These new possibilities are enabled by combining DuPont™ Pyralux® TK flexible circuit materials together with the interconnect design and manufacturing expertise of Molex®. By leveraging the materials and interconnect expertise from both companies, designers are afforded the opportunity to achieve desired performance metrics for the increasing frequency and speed required in today's electronic designs.

Advantages of Flexible Interconnects

The routing of signals within densely packaged electronics can be very challenging. A flex circuit design offers specific advantages versus a cable or printed circuit board solution.

- Increased airflow within the system by reducing a traditional cable bundle to the thinness of a flex circuit
- Tighter bend radii than a cable assembly can offer
- High reliability in dynamic hinge or drawer applications
- Three dimensional packaging options and the ability to manage mechanical tolerances vs. a traditional printed circuit board design
- Lower insertion/return loss materials vs. traditional FR4
- Controlled impedance design
- High speed/frequency designs with numerous interconnect options

New Flex Materials Options from DuPont

One limitation of current flex materials is they generally have higher loss than coax based interconnect. The main reason for this is that signal lines must be very narrow and thin to achieve the thin geometries of flex interconnect. Additionally, the traditional adhesives used to make planar stripline structures have high dielectric loss. There is not much that can be done about the first limitation due to the inherent nature of the laws of physics; the problem of high dielectric loss can be addressed by using different adhesive technology.

Pyralux TK is a material system that replaces the traditional higher loss acrylic adhesive with a Teflon® based material. The resulting structure has a dielectric loss up to an order of magnitude lower than traditional flex adhesives.

Interconnect and Flex Circuit Manufacturing Expertise from Molex

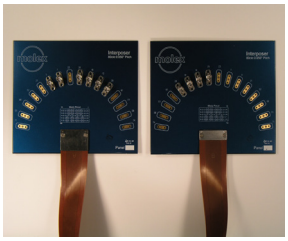
Molex partnered with DuPont to offer flex circuit assemblies using Pyralux TK material, together with a wide breadth of high speed interconnect options.

Molex offers full design and manufacturing capabilities to provide turnkey flex interconnect solutions. Molex has over 30 years experience in the design and fabrication of high performance flex circuits and over 70 years experience in the design and manufacture of connectors. Molex specializes in high speed flex circuit design and managing the balance between electrical performance criteria and the mechanical requirements of the system.

Examples Illustrating Improved High Frequency Performance

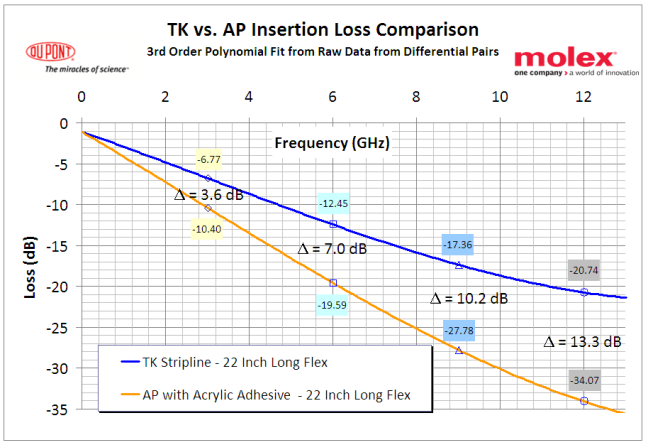
Direct Loss Comparison of Long Lengths of Flex Interconnect

A test vehicle was designed by Molex based on a standard long flex interconnect. One of the reasons this vehicle was chosen is that the length requirement (22 inch long) was difficult to achieve with flex circuit materials without suffering a great deal of signal loss. The picture below shows both ends of the test vehicle in the state which it was tested.



DuPont Collaborates with Molex on New High Speed Flexible Interconnects

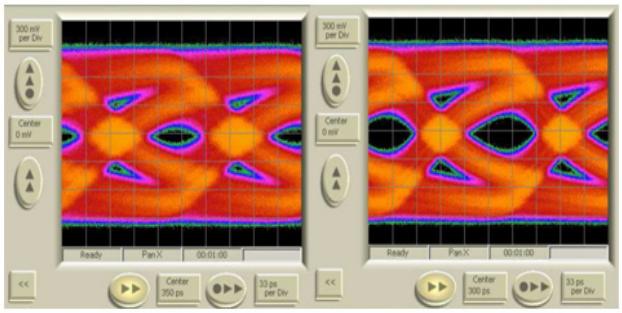
An interposer style connector attached to the flex circuit was used to connect the flex to the fixture board. The insertion loss of the flex plus the interposer was measured and the data shown in the following chart. This plot reflects the average of five differential pairs per material type.[1]



The reduction in insertion loss is quite significant and becomes greater as frequencies increase. This opens up more options to the interconnect designer. The reduced insertion loss can be applied to the loss budget or lengths of flex interconnect can be increased depending on system needs.

Analysis of Eye Patterns at 6 Gbits/second

The same test vehicles described above were subjected to a 31bit long Pseudo Random Bit Stream (PRBS-31) at 6 Gbits/second to evaluate performance in physical interconnects. The eye patterns data provided below is based on actual measured signals in differential pairs, not simulated from S-Parameters. The eye pattern test reveals there is a reduction in insertion loss with the TK material, as seen in the eye height improvement, and there is also an increase in the eye width.[1]



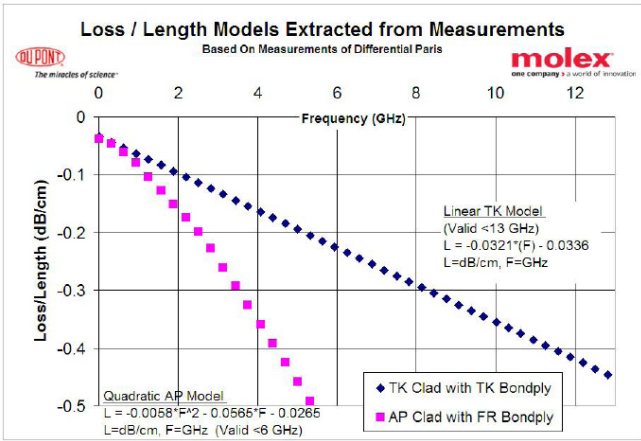
Pyralux® AP **Pyralux® TK**

AP		TK		
109.4	Jitter-PP (ps)	82.0	25% Improvement	Improved due to lower Dk of TK material. Signal travels faster through TK
59.4	Eye Width (ps)	87.7	48% Improvement	Improved due to lower Dk of TK material. Signal travels faster through TK
201	Eye Height (mV)	373	85% Improvement	Improved due to lower loss in TK
1.8	Digital SNR (db)	2.6	+0.8 dB Improvement	Eye height and width improvement combines to yield better system performance

Analysis of Loss Per Unit Length – Existing versus New Flex Materials

To determine the mechanism of the loss benefit, the same test structure was evaluated but with different lengths. Lengths of 22, 11 and 6 inch were evaluated. From this, the effect of the flex by itself can be determined by measuring loss of each structure. A valuable figure of merit, loss per unit length, can be determined by evaluating the difference in loss and dividing this by the difference in length. This eliminates the effect of the fixture and connector. Results of this analysis are shown below.[1]

DuPont Collaborates with Molex on New High Speed Flexible Interconnects



At frequencies higher than 1 GHz, results showed increasingly significant improvement in insertion loss characteristics for flex circuits built with Pyralux® TK vs. standard Pyralux® AP materials.

SUMMARY

The advances offered with the DuPont™ Pyralux® TK flexible circuit material in higher frequency flex circuit designs will allow significant increases in signaling frequency while maintaining the loss characteristics of current lower frequency designs.

Together DuPont and Molex can offer the advanced materials and interconnect options to propel your system designs to the next level of performance.

[1]Data shown is the result of laboratory experiments within a given experimental design under controlled conditions. It should not be used to establish specification limitations or used alone as the basis of design. DuPont does not guarantee the usefulness of the information or the suitability of its products in any given application. Users should conduct their own tests to determine the appropriateness of products for their particular purposes and applications.

This information contained herein is based on data believed to be reliable, but DuPont [and Molex] make no warranties, express or implied, as to its accuracy and assumes no liability arising out of its use.

K-26037 12/12