"Flex Electronics – Packaging Design"

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TAS Consulting (tbarcley@earthlink.net)

Please come see us at our booth.

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Thermal Analysis Systems

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What is a Flex Circuit?

- Flexible Printed Circuits (FPC) can be made with photolithographic technology or by layering copper between laminate layers.
- Flexible circuits are typically used where electrical connectors are required in 3 axes of where the assembly needs to flex during usage – think of cameras and cell phones.

So Flex Circuits solve weight and bulk issues (much lighter and smaller than cables and harnesses.

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What Industries use Flex Circuits?

- Due to weight savings – Automotive, Military, Aerospace, Rockets, etc.
- Due to ease of manufacturing – Commercial and High Volume Manufacturing
- Due to space saving attributes – wearables, Outdoor Equipment, Computer Equipment, and High Tech.

Basically – EVERYONE!

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Construction of a Flex Circuit

- Single Sided –use a single conductor layer of either a metal or conductive polymer on a dielectric film.
- Double Access or Back Bared Flex – still have only a single conductor but allows access from both sides.
- Double Sided – use two conductive layers. Advantage of this is it allows crossover connections to be made.
- Multi-layer Flex – use three or more layers of conductors. The layers may or may not be continuously laminated together to allow for maximum flexibility.
- Rigid Flex – hybrid of flex and rigid boards.

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What Materials are used?

- Base material – provides the foundation of the laminate. Can be polyester (PET), polyimide (PI), polyethylene napthalate (PEN), Polyetherimide (PEI) or various fluoropolymers (FEP). Polyimides are most common.
- Bonding adhesive – this is typically the performance limiting element of the construction. Many polyimide flex circuits employ adhesive systems of different polymer families.
- Metal Foils – this is the conductive element – typically a copper foil.

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Common Issues in Flex Circuit?

- Length and Routing - Use 3D Mockups.
- Design with a bias for extra copper – it adds dimensional stability.
- Service loops and staggered lengths.
- Routing concerns and vias
- Controlled Impedances and Etch Factors
- Ground Plane flexibility.

All these can be fixed with little or no cost.

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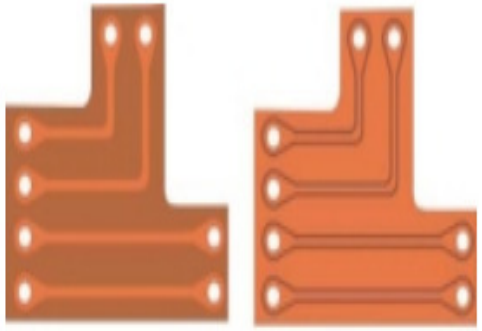
Routing and Bias for Copper



Use 3D Mock ups and Design Rules

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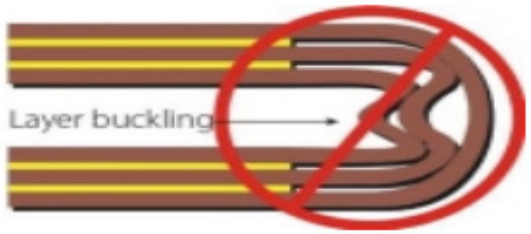
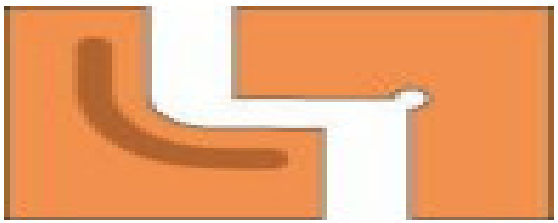
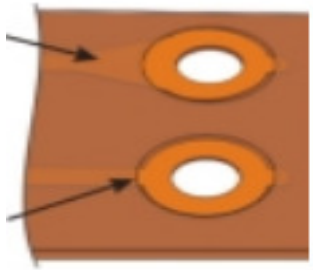
Service Loops, Staggered Lengths, Routing, and Vias







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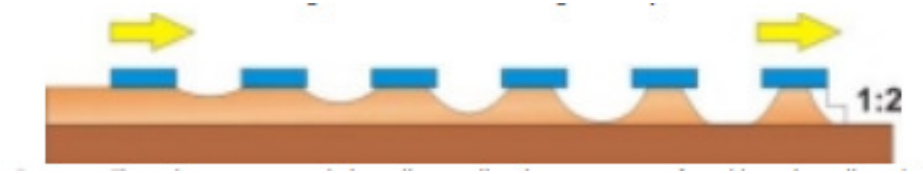
Controlled Impedances and Etch Factors



Etch factor is 1:2 ratio lateral to up/down direction.

Controlled impedance, noise reduction, and crosstalk avoidance are all affected by the etch factor.

Check with your manufacturer to ensure the tolerance you need can be provided.

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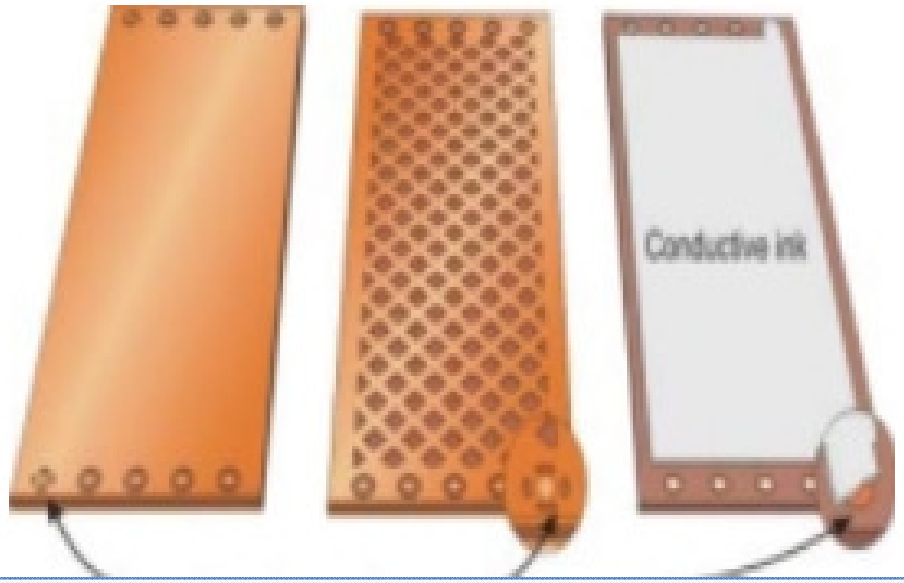
Ground Planes



Cross-hatching is more flexible than solids, but a screened on conductive ink is even more flexible.

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Conclusion

- This presentation showed some of the basic rules for flexes.
- Advanced rules would include blind vias, surface mount components, testing, high densities, and adding stiffeners.

Flex Circuits solve weight and volume issues in electronics packaging and are advancing more each year.

THANK YOU!

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