

Hello, I'm **Ken Gilleo of ET-Trends with a *CircuiTree* 2-Minute Tip** on "Flex - From Inner Space to Outer Space".

After 20-years in the flex circuit industry, I'm still amazed at what this enabling technology can do. Flex is the world's smallest, biggest, longest, cheapest - but most expensive printed circuit. Right - it's all things to all people. But, this is more or less true. Low-cost flex is made with cheap, yet excellent polyester film for cost reduction. High-end flex uses polyimide, or LCP film, and some of the very complex military-aerospace multilayer circuits are probably the most expensive ones ever built. But flex is everywhere - yet it's hidden. You have dozens of flex circuits near by. There's at least one flex in your cellphone, desktop computer and laptop. There's actually more since every hard drive has a flex circuit and every display has least one. Try designing a cost-effective disk drive without flex - it may be impossible since the circuit for the disk drive head must handle 100's of millions of flexing cycles without failure. Flex is the time-tested enabling technology here.

What about inner space. Flex is used in pacemakers and will likely be used for immersing MEMS-based implantable drug monitor-dispensers. And several labs are working on electronic retinas for the blind using very thin flex for the interface. The flex connects to electronic eyeglasses in one product. Flex is also in most hearing aids.

How about outer space? Flex has been riding rockets for decades. It's been in just about every probe and satellite. Flex connects the solar arrays in the International Space Station where they are deployed by unfolding. And just recently, more solar arms were added - enabled by flex. Flex is light and strong, but can take hostile extremes in space especially wide temperature variations. There's also the damaging solar wind - but thin silica was sputtered onto the space flex. Flex is also on Mars. Those fantastic little Mars Rovers used flex in many places, but the extendable arm was enabled by multilayer flex. And it really gets cold - and hot - on Mars.

So, cheers to flex, first patented in 1902, and to those who make the materials, design, fabricate and use flexible circuitry. You are enabling 10's of thousands of products, although your results are typically hidden away inside. But without you, and without flex, disk drives wouldn't function, cars would stop, phones would be silent and the world as we know it would end. This has been Ken Gilleo, of ET-Trends, with your *CircuiTree* Two-Minute Tip.