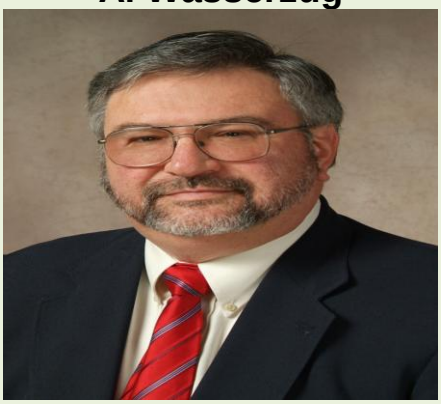
IPC Electronics Midwest 2010

Sculpted Flex Circuits as an Electronics Packaging Solution

Al Wasserzug



Vulcan Flex Circuit Corporation

Biography:
Director of Corporate Development

Al Wasserzug is a 32 year veteran of the PWB Industry with career emphasis on Flex Circuits for defense applications. He has Bachelors degree in Business Administration and has held various management positions in PWB manufacturing companies – from production, engineering and sales to President and CEO. Al is a published author and a long time participant with IPC, currently serving on several committees. Al is Director of Corporate Development for Vulcan Flex Circuit Corporation of Londonderry, NH, a wholly owned subsidiary of Vulcan Electric Company of Porter, ME.

Executive Summary:
Sculpted Flex Circuits are a very cost effective, low profile termination solution that is not very well known. These Flex Circuit hybrids can provide the user a simple interconnection between circuit boards or a circuit boards and anything else, which does not require connectors. This eliminates the need for the space taken up on a circuit board by traditional connectors. Sculpted Flex Circuits can carry high current/voltage and can be shielded for signal integrity. And they can easily be fabricated from commercially available materials, with standard PWB processes and be certified to common DOD and industry specifications.

This presentation will define the Sculpted Flex Circuit, explain the fabrication techniques and explore common applications. The most interested audience will be the designers, technicians, engineers and systems people at the EMS to OEM level.

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Sculpted Flexible Circuits

as an

Electronics Packaging Solution

Mr. Al Wasserzug

VULCAN FLEX CIRCUIT CORPORATION

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Sculpted Flexible Circuits

- What are Sculpted Flexible Circuits?
- What is the History of Sculpted Flexible Circuits?
- What are the Benefits of Sculpted Flexible Circuits?
- How are Sculpted Flexible Circuits Made?
- What are some of the Value-Added Options Available for Sculpted Flexible Circuits?
- What types of lead termination is available with Sculpted Flexible Circuit?
- How are Sculpted Flexible Circuits Most Commonly Used?
- What are the Limitations & Challenges of Sculpted Flex Circuits?
- Sculpted Flexible Circuits – In Summary
- Question & Answer

What Are Sculpted Flexible Circuits?

- A Sculpted Flex Circuit is a standard flex circuit with one or more conductive layers in which one or more of those conductive layers is made of a material (usually copper) that has been "sculpted" into different thicknesses on the same layer plane.

- Sculpted Flex Circuits are otherwise similar in appearance and functionality to other standard flex circuits.

  - Single or double-sided (Type 1 & 2)
    - ✓ With or without Silver or Carbon shields, one or both sides
  - Multi-layered (Type 3)
    - ✓ as inner-layer with individual address
  - Rigid-Flex (Type 4)
    - ✓ as inner-layer with individual address
  - All Types Sculpted Flex Circuits can be certified to IPC & DSCC specifications
    - ✓ MIL-P-50884
    - ✓ MIL-PRF-31032
    - ✓ IPC-6013

What is the History of Sculpted Flexible Circuits.

- Sculpted Flex Circuits were developed and then patented by Joseph “Jody” Roberts and Barry Ostman on April 25, 1978 under patent no. 4085502 and the patent assigned to Jody’s company A.C.T. (Advanced Circuit Technology).
- Additional Patent Numbers: 2973502, 3079458, 3168617, 3264152, 3391246, 3547718, 3601755, 3808679 and 3888745.
- The patented item was called a “Jumper Cable” and was marketed for years under the term “Sculptured Flex Circuit”.
- A.C.T. designed and fabricated the bulk of the patented items.
- Several other companies licensed in U.S., Canada and the U.K.
- Patent expired in 1998 – technology in the public domain.
- Various levels of technology now available from a number of manufacturers.

What are the Benefits of Sculpted Flexible Circuits

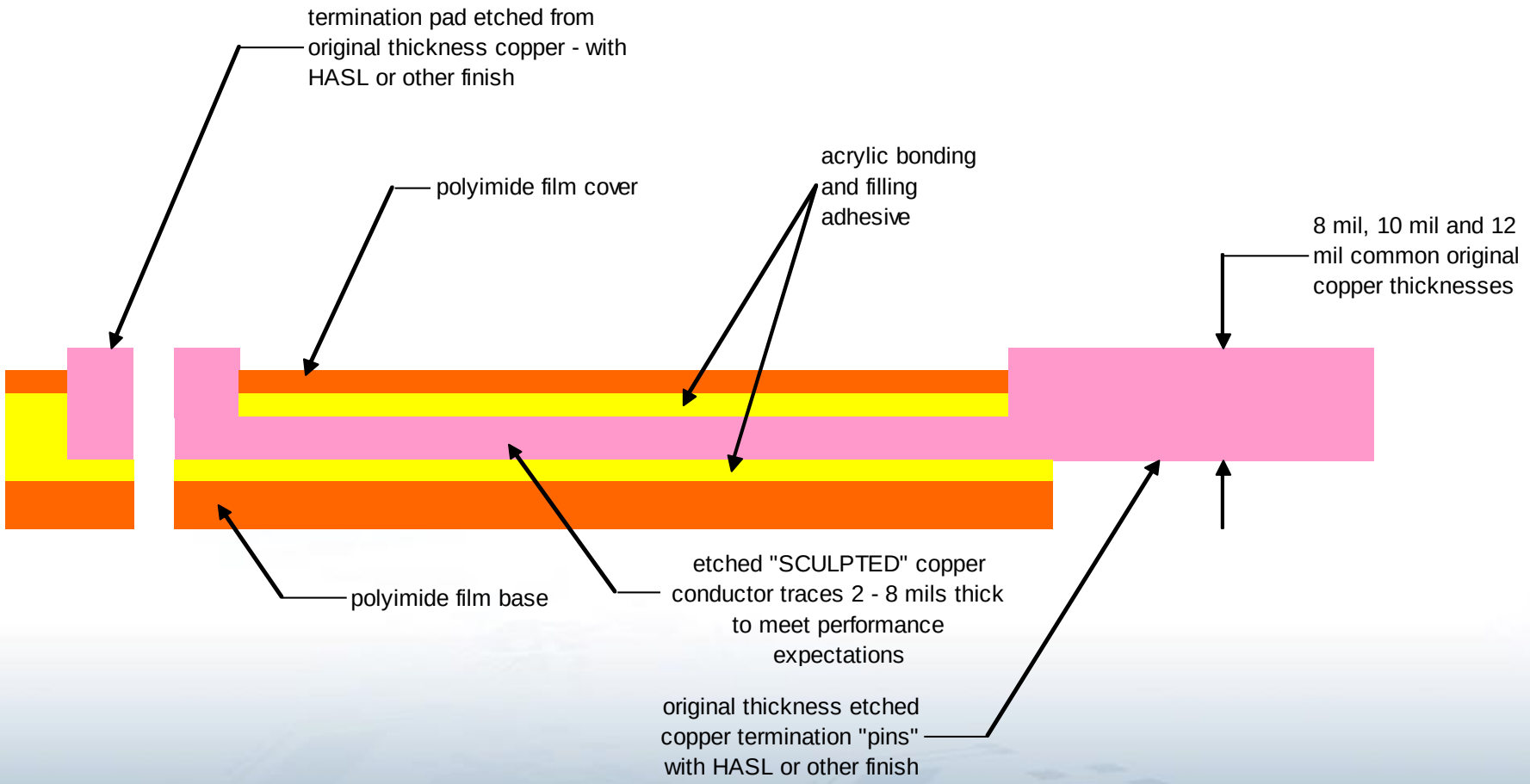
- Sculpted Flex Circuits have many benefits
  - A more robust and reliable alternative to ribbon cable/wire
  - Customized and isolated termination configurations
  - Increased flexibility outside of ruggedized termination area
  - A very low profile and rugged interconnection
  - Eliminate the need for connectors
  - Capability to carry high current
  - Reduce weight and increase space
  - Reduce cost as a relatively inexpensive Mil certified item

How Are Sculpted Flexible Circuits Made?

- Sculpted Flex Circuits are made through a series of photo lithography and chemical etching processes to created the “sculpted” features.
- Several different photo-plotted film patterns are used progressively in a mask, expose, develop and etch process to create the “sculpted” features.
- Otherwise processing is very similar to standard flex circuits with allowances made for the protection and integrity of the sculpted features.
- Common conductive material is ½ hard RA copper, C11000 per ASTM B152; ETP (electrolytic tough pitch) 99.9% pure. ¼ hard copper is difficult to source, but may also be used.
  - 6 ounce per square foot = 8 mils thick
  - 7 ounce per square foot = 10 mils thick
  - 8.5 ounce per square foot = 12 mils thick
  - 10 ounce per square foot = 14 mils thick
  - 14 ounce per square foot = 20 mils thick

  8, 10 & 12 mils are the most common
- Most common: Dielectrics is un-reinforced polyimide films; adhesive is modified acrylic; conductor finish (over copper) is HASL (hot air solder level)

How Are Sculpted Flexible Circuits Made?

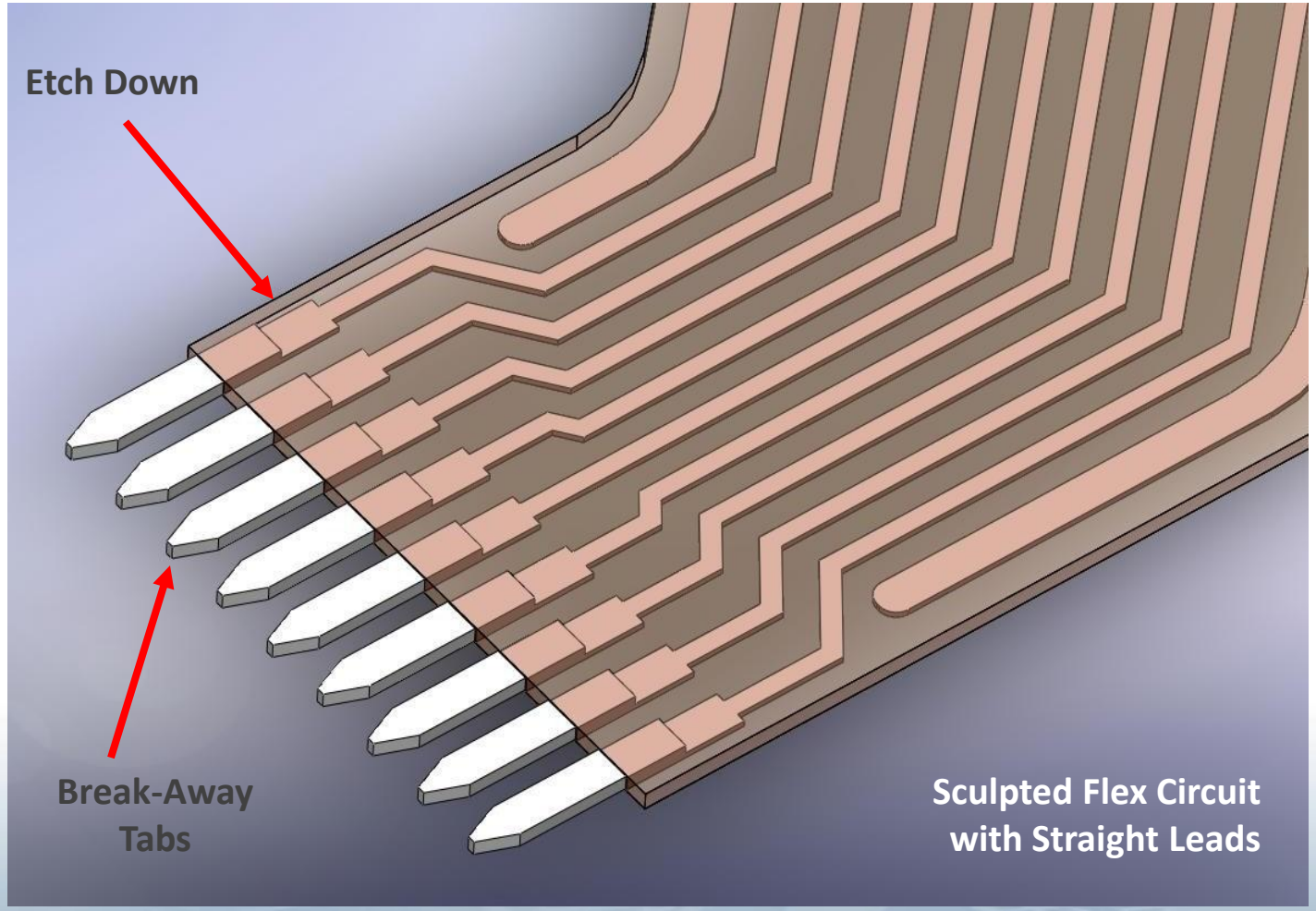


What are some of the Value-Add Options Available with Sculpted Flexible Circuits

- Sculpted Flex Circuits are available with any combination of the following value-added options (listed in order of commonality):
  - Sculpted finger bending:
    - ✓ 90º and 90º staggered
    - ✓ "S" bend and "S" bend staggered
    - ✓ "Hooks", "Turrets" and a vast array of other shapes can also be made
  - Gerber file generation (reverse engineering/original layout)
  - Connectors assembled, soldered and potted
  - Silver ink shields for EMI/RFI shielding
  - Localized mechanical support with FR-4 stiffeners
  - Localized mechanical support with Kapton® stiffeners
  - RoHS finishes:
    - ✓ ENIG or ENIPIG
    - ✓ Immersion Ag or Sn
    - ✓ "Lead Free" HASL (copper/tin alloy)

"Kapton" ® is a registered trademark of E.I. DuPont de Nemours

Types of Sculpted Flexible Circuit Leads



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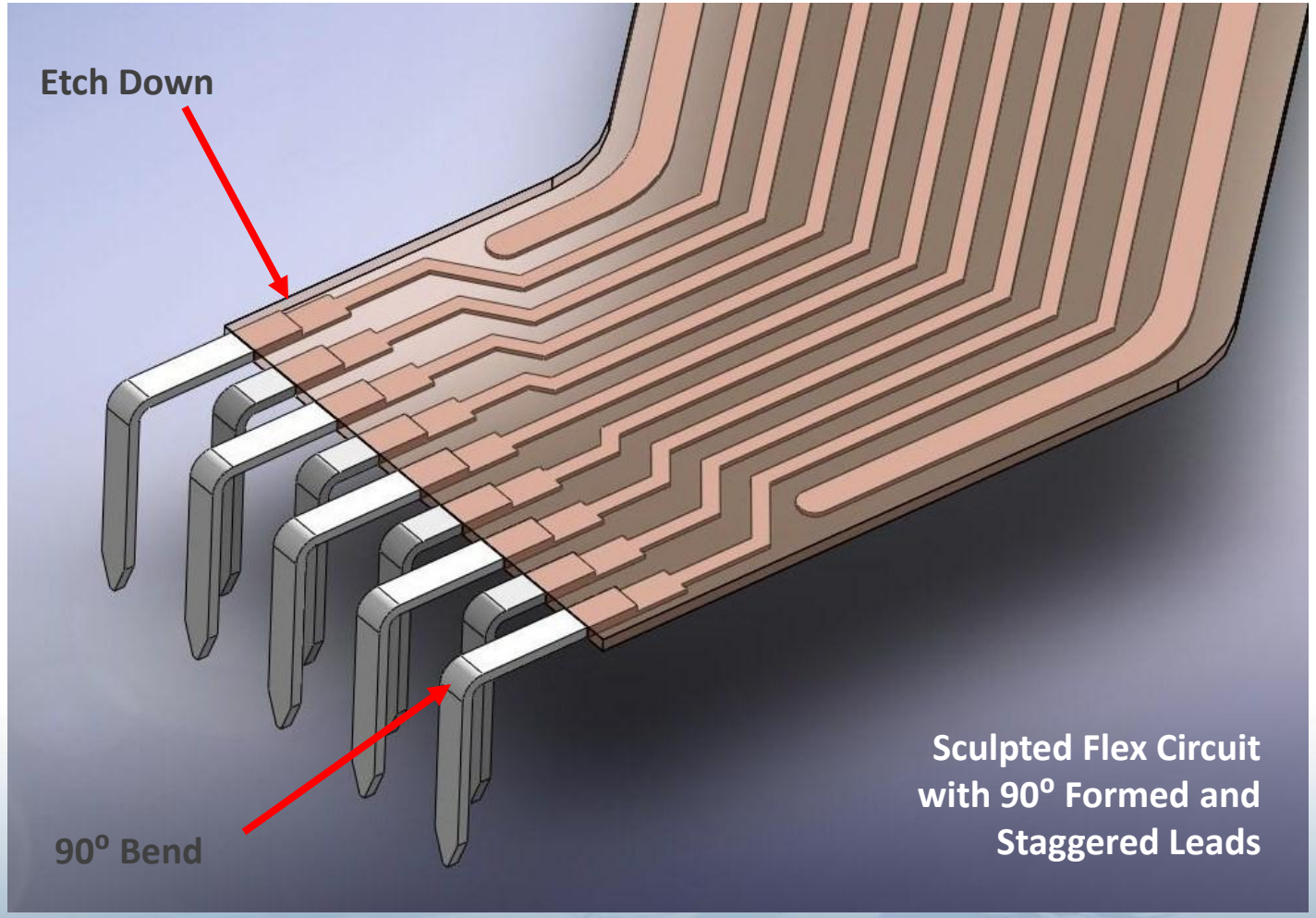

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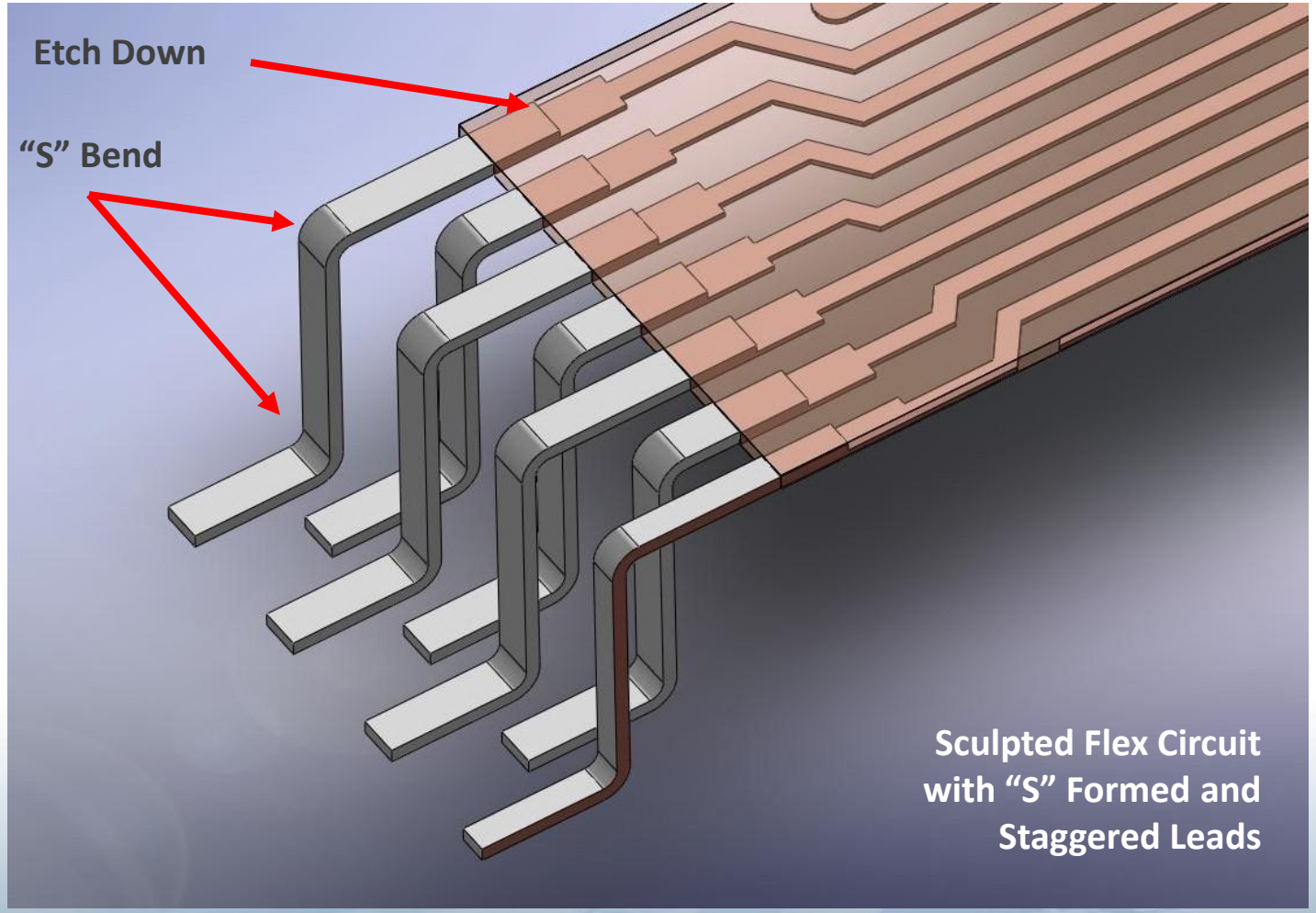

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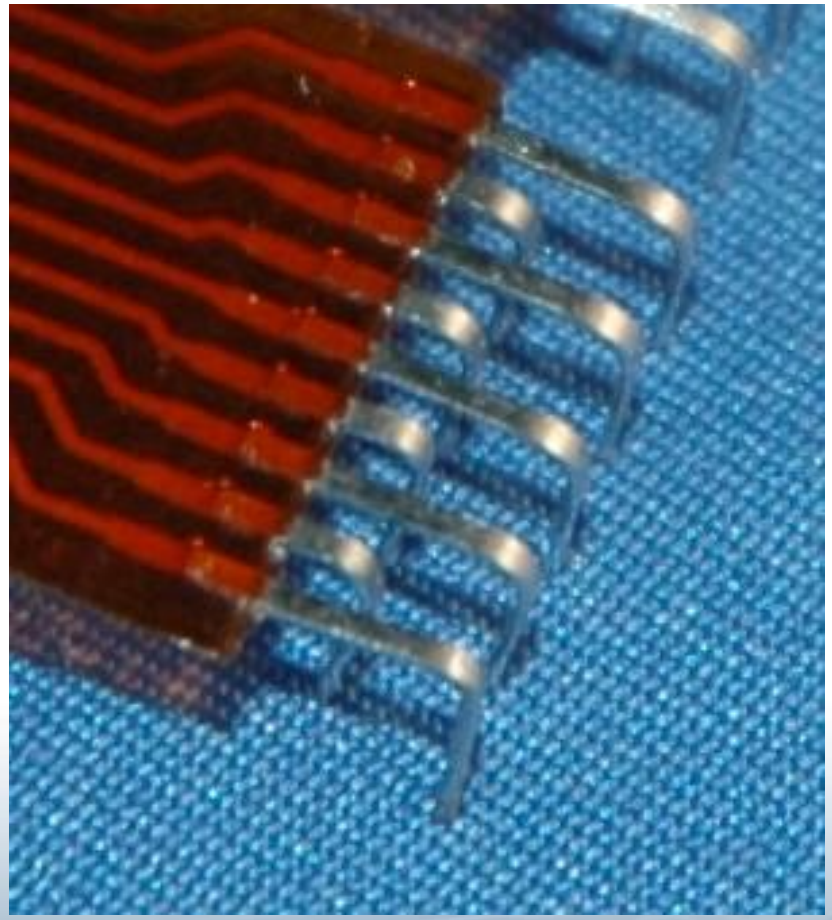

Sculpted Flex Circuit with leads formed 90° and staggered

How Are Sculpted Flexible Circuits Most Commonly Used?

- Sculpted Flex Circuits are used in a variety functions
  - Board-to-board jumper
  - Low profile interconnection
  - Connector/switch/component-to-board jumper
  - High current BUS
  - High voltage ground
  - Precision part-to-part interface
- Sculpted Flex Circuits are used in a variety of applications
  - Cockpit avionics
  - Missile guidance
  - Small/medium caliber munitions
  - Ruggedized & handheld communications
  - Micro medical electronics
  - Test & measurement instrumentation
  - Industrial sensors and controls

What Are the Limitations & Challenges Of Sculpted Flexible Circuits?

- Sculpted Flex Circuits do not hold up well in a dynamic flex application
- Sculpted Flex Circuits will have a larger minimum bend radii
  - Approximately 12 – 15 X material thickness
  - Could be much higher for advanced constructions
- Sculpted Flex Circuits may require special packaging to protect formed sculpted features during transit, handling and prior to assembly
- Sculpted Flex Circuits may need to be un-soldered to be disconnected; no quick disconnect like a connector

These can be very minor limitations in respect to the value of the solutions and reliability that Sculpted Flexible Circuits can provide.

Sculpted Flexible Circuits - In Summary

- Sculpted Flex Circuits are a low profile, custom interconnect which is more reliable than ribbon cable or wire and can eliminate the need for costly connectors.
- Sculpted – or “Sculptured” - Flex Circuit technology is no longer covered by a patent. The technology is in the public domain.
- Sculpted Flex Circuits are relatively inexpensive and can be used in disposable applications.
- Sculpted Flex Circuits can be fabricated and certified to all of the same DSCC/DOD specifications as standard flex circuits, making them an easy choice for battlefield or flight hardware.
- Sculpted Flex Circuits have few limitations over wire or ribbon cable.
- Sculpted Flex Circuits are already used in most major electronic systems.

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THANK YOU

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