Maximum Performance for Demanding Applications

The Molex Approach

At Molex, we take a multidimensional approach to develop complete, integrated solutions that turn your ideas into reality. With the industry’s broadest line of printed electronics and the expertise to work through your mechanical rigors, we can advise you on the best fit for your needs, balancing cost, performance, durability, weight and other requirements.

Learn whether a Molex copper flexible circuit is right for your end application, and start designing your solution today. Visit www.molex.com/product/ipd/copperflex.html

CIRCUITS DESIGNED WITH A RANGE OF CAPABILITIES

Layer Count
2 to 8 layers

Standard Panel Sizes (Others Available)
2400 by 600mm
250 by 600mm

Base Material
Rigid and Flex [MEK Solvent Resistant, UL-94 V-0, 5VA, 94V-0, FM Class 2]

Stiffeners
Thermal Set or Pressure Sensitive Adhesive

Shielding
Epoxy, Copper, Silver Ink, Shielding Rim

Hole Size
Drilled, 0.20mm Minimum
Laser-Drilled Holes Available

Aspect Ratio
6:1

Soldermask
Copper, Nickel, Gold, Silver, Gold Filled, Tin Filled

Etch Type
Chemical Etch, Laser Etch, Laser Drilled

J-STD-001 Standards

Quality and Testing
IPC 6013 Class 3
Mechanical
Bend Radius Calculator, Environmental, RF, Optical, Mechanical, Surface and Metallurgical Analysis, Thermal Analysis and Imaging, SEM, X-Ray, EMI

Electrical
Impedance Calculator, Crosstalk, Skew, Insertion Loss, Return Loss, Eye Diagram

Certifications
ISO 9001:2008
ISO 14001:2004
TS 16949
IPC 6500A Certified
UL 94-V0

Assembly
Through Hole, SMT, BGA, Press-Fit, Mechanical Hardware

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MOLEX COPPER FLEXIBLE CIRCUIT SOLUTIONS

Maximum Performance for Demanding Applications
INNOVATIVE COPPER FLEX CIRCUITS

Molex Flexible Printed Circuit Technology is the answer for your most challenging interconnect applications.

We are your total solution for flexible printed circuitry because we design and manufacture both the Flex and the connectors. A flexible printed circuit (FPC or Flex) is an ultra-reliable technology. An FPC can be the best solution for creating products that are complex, small, lightweight or have harsh environmental conditions. Flex can be designed to meet a wide range of temperature and environmental extremes.

This custom solution has a variety of applications. Flex circuits are excellent for designs with high-density circuitry, and for dynamic applications such as high-speed, high-density, and high-temperature fluctuations. Flex can be designed to meet a wide range of temperature and environmental extremes.

There are several advantages that flexible printed circuits have over other interconnect devices:

- **Signal Integrity** — The material used in the construction of Flex minimizes signal loss, maximizing high-speed integrity.
- **Impedance Control** — Flex promotes a robust design pitch due to the close proximity of circuitry and ground planes/shields.
- **Temperature Resistance** — Materials used in the construction of Flex have closely matching thermal expansion rates. This causes Flex to be suitable for hot and cold temperatures as well as large temperature fluctuations.
- **Thermal Management** — Flex does not require cooling from both sides. It also designates heat quickly.
- **Space Reduction** — Flex is able to accommodate three dimensions. It can be used in several packaging and even used in order to fit into a much smaller device enclosure.
- **Weight Reduction** — Flex is significantly thinner and lighter than traditional circuit boards; products using Flex will naturally be lighter.

A complete source for flex and rigid circuit design, development, manufacturing and assembly

**Design and manufacture customer interconnect solutions**
- Molex flex circuit and connector manufacturing expertise
- Connector customization to meet application requirements
- Molex assembly expertise
- One supplier – complete assembly

**Full range of flex circuit and assembly technologies**
- Double-sided for flex assemblies
- Single, double, multi-layer and rigid flex; up to 8 layers

**Design the flex assembly with expertise in electrical, mechanical, reliability and manufacturing properties**
- Multidisciplined engineering support
- Optimize electrical, mechanical, flexibility and manufacturing requirements to meet application needs
- Multidisciplined background in mechanical design and manufacturing
- Minimize points of flex stress, provide longer-term reliability products
- Streamlined design approach to flex

**Standards certification support**
- Industry leader in signal integrity design
- Expertise in high-speed design and materials support
- Full signal integrity modeling and testing capabilities
- Internally developed impedance calculator based on manufacturing parameters and material selection

**Proven Molex reliability**
- Proven Molex reliability and builds confidence in your design
- Early engagement with complete design for manufacturing to streamline production release and build

**Molex DELIVERS:**
- Design engineering support
- Proven Molex reliability
- In-house value-add capabilities

Designs your assembly with expertise in:
- Electrical, mechanical, reliability and manufacturing properties
- Multidisciplined engineering support
- Optimize electrical, mechanical, flexibility and manufacturing requirements to meet application needs
- Multidisciplined background in mechanical design and manufacturing
- Minimize points of flex stress, provide longer-term reliability products
- Streamlined design approach to Flex

**Standards certification support**
- Industry leader in signal integrity design
- Expertise in high-speed design and materials support
- Full signal integrity modeling and testing capabilities
- Internally developed impedance calculator based on manufacturing parameters and material selection

**Challenges our customers to ensure that the flex interconnect is not overdesigned**
- Simplicity design to meet application requirements while managing costs
- Early engagement with complete design for manufacturing to streamline production release and build

**Multiple manufacturing locations**
- Design recovery backup
- Low-cost geography manufacturing
- US and Taiwan design centers
- China, Taiwan and Mexico manufacturing facilities
- ISO 14001, ISO 9001 and TS 16949-certified facilities

**Locations**
- Design Centers: St. Paul, MN; Taipei, TW
- Flex Circuit Manufacturing: Taipei, TW
- Assembly Fabrication: Naperville, IL; Taipei, TW; Guadalajara, MX; Dongguan, PRC

**Molex DITELVES:**
- Design engineering support
- Proven Molex reliability
- In-house value-add capabilities
CIRCUITS DESIGNED WITH A RANGE OF CAPABILITIES

Flex and Rigid Flex (Typical)

Layer Count
1 to 8 layers

Standard Panel Sizes (Others Available)

- 987650-0481 460mm
- 350mm

Base Material
Rigid and Flex, MC-6013 Subclass: Polycarbonate/Thermosetting Resin

Stiffeners
- Aluminum
- Stainless Steel

Shielding
- Etched Copper, Silver Ink, Shielding Rim

Hole Size
- Drilled: 0.20mm Minimum
- Laser-Drilled Holes Available

Aspect Ratio
6:1

Soldermask
- Coverage Film
- LPI

Inkjet/SilkSCREEN Legend Options
- White, Yellow, Black

Finish Plating
- OSP
- Electroless Nickel/Immersion Gold (ENIG)
- Electroless Nickel/Electroless Palladium/Immersion Gold (ENEPIG)
- Electrolytic/Hard Gold
- Electrolytic Tin

Hole to Edge
- ±0.127

Cutline to Edge
- ±0.254

Outside Dimensions
- ±0.051

Trace to Edge
- ±0.051

Title
- Copper Flexible Circuit Soldermask

Perimeter Tolerances (millimeters)

No Finish
- ±0.127
- ±0.254

Chemical Milled Die
- ±0.051
- ±0.127

Inner Layers
- ±0.051
- ±0.127

Outer Layers
- ±0.051
- ±0.127

Quality and Testing
- IPC-6013 Class 3
- Mechanical
- Electrical

Certifications
- ISO 9001:2008
- ISO 14001:2004
- TS 16949
- IPC 600/610 Certified
- ULV94-0

Assembly
- Through Hole, SMT, BGA, Press-Fit, Mechanical Hardware

The Molex Approach

All Molex, we take a multidimensional approach to develop complete, integrated solutions that turn your ideas into reality. With the industry’s broadest line of printed electronics and the expertise to work through your mechanical issues, we can advise you on the best fit for your needs, balancing cost, performance, durability, safety and other requirements.

Learn whether a Molex copper flexible circuit is right for your end application, and start designing your solution today. Visit www.molex.com/products/copperflex.html
Molex Flexible Printed Circuit Technology is the answer for your most challenging interconnect applications.

- **Interconnect Assemblies**: Virtually unlimited variety of interconnect options, reduces assembly time, excellent thermal management.
- **Jumpers**: Typically 2 or more layers, tight tolerance, excellent vision, high thermal characteristics, zinc flake available.
- **High-Density Assemblies**: Typically 2 or more layers, high level of signal integrity, high thermal characteristics, excellent thermal management.
- **High-Speed Assemblies**: Typically 2 or more layers, large number of interconnect options, high signal integrity, impedance control, low signal loss.
- **Rigid Flex**: Surface mounted on both sides, press-fit connector capability, combination of flexible polyimide and rigid FR4.
- **Resistant Flex**: Impedance control, improved reliability.

**PRODUCT** | **FEATURES** | **FLEX TYPES**
---|---|---
Interconnect Assemblies | Virtually unlimited variety of interconnect options, reduces assembly time, excellent thermal management | Single-sided, Double-sided, Multi-layer
Jumpers | Typically 2 or more layers, tight tolerance, excellent vision, high thermal characteristics, zinc flake available | Double-sided, Multi-layer
High-Density Assemblies | Typically 2 or more layers, high level of signal integrity, high thermal characteristics, excellent thermal management | Double-sided, Multi-layer
High-Speed Assemblies | Typically 2 or more layers, large number of interconnect options, high signal integrity, impedance control, low signal loss | Multi-layer
Rigid Flex | Surface mounted on both sides, press-fit connector capability, combination of flexible polyimide and rigid FR4 | Rigid Flex
Resistant Flex | Impedance control, improved reliability | Double-sided, Multi-layer

**A complete solution for flex and rigid flex circuit design, development, manufacturing and assembly**

- **Design and manufacture customer interconnect solutions**: Molex flex circuit and connector manufacturing expertise.
- **Connector customization to meet application requirements**: Molex assembly expertise.
- **One supplier – complete assembly**: One-stop shop for flex assemblies.
- **Design the flex assembly with expertise in electrical, mechanical, reliability and manufacturing properties**: Molex assembly expertise.
- **Impedance control design and manufacture**: Molex assembly expertise.
- **Value-add assembly**: Through hole, SMT, BGA, press-fit and mechanical hardware.

**MOLEX DELIVERS:**

- **Design engineering support**
  - **Proven Molex reliability**
  - **In-house value-add capabilities**
  - **Challenge our customers to ensure that the flex interconnect is not overdesigned**
  - **Simplify design to meet application requirements while maintaining costs**
  - **Early engagement with complete design for manufacturing to streamline production release and builds**
- **Multiple manufacturing locations**
  - **Disaster recovery backup**
  - **Low-cost geography manufacturing**
  - **US and Taiwan design centers**
- **ISO 14001, ISO 9001 and TS 16949-certified facilities**
- **Dongguan, PRC**
- **Innovative Copper Flex Circuits**

**Molex Flexible Printed Circuit Technology**

- **Weight Reduction**: Flex is able to occupy three dimensions, it can be bent around packaging and even used as if to fit into a much smaller device enclosure.
- **Space Reduction**: Flex is also designed to be thin.
- **Weight Reduction**: Flex is significantly thinner and lighter than traditional circuit boards, products using Flex will naturally be lighter.
- **Typical thermal resistance**: The construction of Flex causes heat to disperse both sides, the material used in the construction of Flex has excellent thermal expansion rates. This causes Flex to be suitable for hot and cold temperatures as well as large temperature fluctuations.
- **Thermal Management**: Flex does not require cooling from both sides; it also does not heat quickly.
- **High speed**: Flex has excellent thermal characteristics and standard signal integrity.
- **Coiling design**: Elimination of connectors and cables for more compact packaging.
- **Impedance control**: One supplier – complete assembly.
- **Low signal loss**: Molex assembly expertise.
- **Reduced assembly time**: Excellent thermal management.
- **Reduced weight**: Molex assembly expertise.
- **Simpler and more reliable**: FPC interconnects are often used in applications where high signal speed, high density circuitry, and for dynamic applications such as hinge and drawer devices.
- **Excellent for designs with high-temp and environmental extremes**: Flex can be designed to meet a wide range of temperature and environmental extremes.

**Molex Flexible Printed Circuit Technology**

- **Innovative Copper Flex Circuits**

**PRODUCT**

- **Interconnect Assemblies**: Virtually unlimited variety of interconnect options, reduces assembly time, excellent thermal management.
- **Jumpers**: Typically 2 or more layers, tight tolerance, excellent vision, high thermal characteristics, zinc flake available.
- **High-Density Assemblies**: Typically 2 or more layers, high level of signal integrity, high thermal characteristics, excellent thermal management.
- **High-Speed Assemblies**: Typically 2 or more layers, large number of interconnect options, high signal integrity, impedance control, low signal loss.
- **Rigid Flex**: Surface mounted on both sides, press-fit connector capability, combination of flexible polyimide and rigid FR4.
- **Resistant Flex**: Impedance control, improved reliability.

**FEATURES**

- **Virtually unlimited variety of interconnect options**: Excellent thermal management.
- **Reduces assembly time**: Multi-layer.
- **Excellent thermal management**: Single-sided, Double-sided, Multi-layer.
- **Typically 2 or more layers**: Double-sided, Multi-layer.
- **High thermal characteristics**: Double-sided, Multi-layer.
- **Improved reliability**: Double-sided, Multi-layer.
- **Surface mounted on both sides**: Rigid Flex.
- **Impedance control**: Multi-layer.
- **Circuit design**: Multi-layer.
- **High speed**: Multi-layer.

**FLEX TYPES**

- **Single-sided**: Molex assembly expertise.
- **Double-sided**: Multi-layer.
- **Multi-layer**: Molex assembly expertise.

**A complete solution for flex and rigid flex circuit design, development, manufacturing and assembly**

- **Design and manufacture customer interconnect solutions**: Molex flex circuit and connector manufacturing expertise.
- **Connector customization to meet application requirements**: Molex assembly expertise.
- **One supplier – complete assembly**: One-stop shop for flex assemblies.

**Design the flex assembly with expertise in electrical, mechanical, reliability and manufacturing properties**

- **Multidisciplinary engineering support**
  - **Optimized electrical, mechanical, flexibility and manufacturing requirements to meet application needs**
  - **Excessive background in mechanical design and manufacturing**
  - **Minimize points of flex stress, provide long-term reliability products**
  - **Sineometric design approach to Flex**

**Standards certification support**

- **Industry leader in signal integrity design**
  - **Specialize in high-speed design and materials support**
  - **Full signal integrity modeling and testing capabilities**
  - **Internally developed impedance calculator based on manufacturing parameters and material selection**

**Challenge our customers to ensure that the flex interconnect is not overdesigned**

- **Simplify design to meet application requirements while maintaining costs**
- **Early engagement with complete design for manufacturing to streamline production release and builds**

**MOLEX DELIVERS:**

- **Design engineering support**
  - **Proven Molex reliability**
  - **In-house value-add capabilities**
Molex Flexible Printed Circuit Technology is the answer for your most challenging interconnect applications.

We are your total solution for flexible printed circuitry because we design and manufacture both the Flex and the connectors. A flexible printed circuit (FPC or Flex) is an ultra-reliable technology. An FPC can be the best solution for creating products that are compact, small, lightweight or have harsh environmental conditions. Flex can be designed to meet a wide range of temperature and environmental extremes.

This custom solution has a variety of applications. Flex circuits are excellent for designs with high-density circuitry, and for dynamic applications such as hinge and drawer devices.

Flex circuits make electronic interconnection both as hinge and drawer devices.

There are several advantages that flexible printed circuits have over other interconnect devices:

- **Signal Integrity** — The material used in the construction of Flex minimizes crosstalk, maximizing high-speed integrity.
- **Impedance Control** — Flex promotes a robust design pitch due to the close proximity of circuitry and ground planes/shields.
- **Temperature Resistance** — Materials used in the construction of Flex have closely matching thermal expansion rates. This means Flex is suitable for hot and cold temperatures as well as large temperature fluctuations.
- **Thermal Management** — Flex does not require cooling from both sides. It also dissogues heat quickly.
- **Space Reduction** — Flex is able to occupy three dimensions. It can be bent, wound and even used, in order to fit into a much smaller device enclosure.
- **Weight Reduction** — Flex is significantly thinner and lighter than traditional circuit boards; products using Flex will naturally be lighter.

### INNOVATIVE COPPER FLEX CIRCUITS

### PRODUCT FEATURES Flex Types

<table>
<thead>
<tr>
<th>INTERCONNECT ASSEMBLIES</th>
<th>FEATURES</th>
<th>FLEX TYPES</th>
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<tbody>
<tr>
<td>Virtually unlimited variety of interconnect options</td>
<td>Single-sided</td>
<td>Single-layer</td>
</tr>
<tr>
<td>Reduces assembly time</td>
<td>Double-sided</td>
<td>Multi-layer</td>
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<tr>
<td>Excellent thermal management</td>
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<thead>
<tr>
<th>JUMPERS</th>
<th>FEATURES</th>
<th>FLEX TYPES</th>
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<tbody>
<tr>
<td>Typically 2 or more layers</td>
<td>Double-sided</td>
<td>Multi-layer</td>
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<tr>
<td>Tight tolerance and spacing widths</td>
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<tr>
<td>Reduces weight</td>
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<tr>
<td>Better thermal characteristics than standard board constructions</td>
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<tr>
<td>20-60 jumpers available</td>
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<tr>
<th>HIGH DENSITY ASSEMBLIES</th>
<th>FEATURES</th>
<th>FLEX TYPES</th>
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<tbody>
<tr>
<td>Typically 2 or more layers</td>
<td>Single-layer</td>
<td>Single-layer</td>
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<tr>
<td>Tight tolerance and spacing widths</td>
<td>Double-sided</td>
<td>Multi-layer</td>
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<tr>
<td>Reduces weight</td>
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<tr>
<td>Better thermal characteristics than standard board constructions</td>
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<tr>
<th>HIGH-SPEED ASSEMBLIES</th>
<th>FEATURES</th>
<th>FLEX TYPES</th>
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<tbody>
<tr>
<td>Typically 3 or more layers</td>
<td>Multi-layer</td>
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<tr>
<td>Large number of interconnect options</td>
<td></td>
<td></td>
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<tr>
<td>High density routing</td>
<td></td>
<td></td>
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<tr>
<td>Impedance control</td>
<td></td>
<td></td>
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<tr>
<td>Low signal loss</td>
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<tr>
<th>RIGID FLEX</th>
<th>FEATURES</th>
<th>FLEX TYPES</th>
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</thead>
<tbody>
<tr>
<td>Surface mount on both sides</td>
<td>Rigid Flex</td>
<td>Multi-layer</td>
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<tr>
<td>Pass-through connector capability</td>
<td></td>
<td></td>
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<tr>
<td>Electrical performance and cables for improved reliability</td>
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<tr>
<td>Combination of flexible polyimide and rigid FR4</td>
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<tr>
<th>RESISTANT FLEX</th>
<th>FEATURES</th>
<th>FLEX TYPES</th>
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</thead>
<tbody>
<tr>
<td>Impedance control</td>
<td>Double-sided</td>
<td>Multi-layer</td>
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<tr>
<td>Coding design</td>
<td></td>
<td></td>
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<tr>
<td>High speed</td>
<td></td>
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</table>

MOLEX DELIVERS:

- **Design engineering support**
- **Proven Molex reliability**
- **In-house value-add capabilities**

A complete solution for flex and rigid flex circuit design, development, manufacturing and assembly

Challenge our customers to ensure that the flex interconnect in not overdesigned.

- **Simply design to meet application requirements while maintaining costs.**
- **Early engagement with complete design for manufacturing to streamline production releases and builds.**

### Multiple manufacturing locations

- **Design recovery backup**
- **Low-cost manufacturing**
- **US and Taiwan design centers**
- **China, Taiwan and Mexico manufacturing facilities**
- **ISO 14001, ISO 9001 and TS 16949-certified facilities**

### Locations

- **Design Centers:**
  - St. Paul, MN; Taipei, TW
  - Guadalajara, MX; Dongguan, PRC
- **Assembly Fabrication:**
  - Naperville, IL; Taipei, TW
  - St. Paul, MN; Taipei, TW
  - Guadalajara, MX; Dongguan, PRC
- **Flex Circuit Manufacturing:**
  - Taipei, TW
- **Assembly Fabrication:**
  - Superflex, IL; Taipei, TW; Guadalajara, MX; Dongguan, PRC

Design the flex assembly with expertise in electrical, mechanical, reliability and manufacturing properties.

- **Multidisciplined engineering support**
- **Optimized electrical, mechanical, flexibility and manufacturing requirements to meet application needs**
- **Extensive background in mechanical design and manufacturing**
- **Minimize points of flex stress, provide long-term reliability products**
- **Simplified design approach to Flex**
- **Standards certification support**

Industry leader in signal integrity design:

- **Simplify design to meet application requirements while maintaining costs.**
- **Early engagement with complete design for manufacturing to streamline production releases and builds.**

- **Simply design to meet application requirements while maintaining costs.**
- **Early engagement with complete design for manufacturing to streamline production releases and builds.**
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CIRCUITS DESIGNED WITH A RANGE OF CAPABILITIES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Values</th>
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<tbody>
<tr>
<td>Layer Count</td>
<td>1 to 8 layers</td>
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<tr>
<td>Standard Panel Sizes</td>
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<td></td>
<td>250 by 600mm</td>
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<td>250 by 600mm</td>
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<td>Base Material</td>
<td>Rigid and Flex, IPC-6011</td>
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<td>Stiffeners</td>
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<td>Stainless Steel</td>
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<td>Shielding</td>
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<tr>
<td>Hole Size</td>
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<td>Aspect Ratio</td>
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<td>Soldermask</td>
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<td>Inkjet/Silkscreen Legand Options</td>
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<td>Finish Plating</td>
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<td>Immersion Gold</td>
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<td>Finishing Copper Trace/Space</td>
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<td>15um Copper – 20um Trace/Space</td>
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<td>Quality and Testing</td>
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<td>Mechanical and Metallurgical Analysis, Thermal Analysis and Imaging, SMT, A Ray Analysis, DFM</td>
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<td>Electrical</td>
<td>Impedance Calculator, Crosstalk, Skew, Insertion Loss, Return Loss, Eye Diagram</td>
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</tbody>
</table>