

HIGH RELIABILITY FLEXIBLE CIRCUITS

FOR THE MEDICAL MARKETPLACE



Tech Etch manufacturers high reliability flex circuits used in the diagnostic imaging, patient monitoring, cardiac management and life science industries. Flexible circuits provide the thinnest and lightest interconnect method available. Their extreme thinness makes them very well suited for dynamic applications where the flex will be in constant or periodic motion. They contribute to reducing overall system complexity by facilitating assembly and eliminating wiring errors. Flexible circuits will conform to the available geometry for connections of electronics located on different planes within the finished electronic device.

This capability is sometimes referred to as 3D packaging.

| Medical Applications Supported |

The demand for wireless, portable, and more complex electronic assemblies has led to the use of flexible circuits in many high reliability medical applications. Tech Etch has developed manufacturing processes to produce the sophisticated circuits required by these electronic devices:

- ♦ Medical Imaging including ultrasound transducers, CT scanners, and X-ray scanners. These circuits are typically multilayer micro via circuits requiring fine pitch trace / space and precise circuit layer registration.
- Implanted Devices including cardio defibrillators, pacemakers, and neurostimulators. These circuits often require telemetry coils, piezo ceramic assembly, and nickel or niobium terminations.
- Drug Delivery Flex circuits supporting external drug delivery pumps often require component assemblies which might include a sensor.
- Medical Instruments including ultrasonic and phaco surgical handpieces. These circuits often require conductor materials other than copper, such as beryllium copper or stainless steel.

| Increasing Complexity of Medical Flexible Circuits |

The advent of more complex electronic assemblies has driven the need for high density interconnect circuits. These difficult designs must be sourced from very capable fexible circuit manufacturers who are able to produce multi-layer, fine-line circuits. Tech Etch will typically use laser drilling technology to fabricate very small micro vias in addition to laser direct imaging to generate equally dense circuit patterns. In some cases these features are so small they cannot be electrically tested using the conventional test fixture process and quality must be confirmed using more sophisticated flying probe electrical test process.

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WINDOWED LEADS

01



CONNECTOR ASSEMBLY





LASER DRILLING



LASER DIRECT IMAGING



SCREENING AND PICK & PLACE



FLYING PROBE ELECTRICAL TEST

| Process Capabilities |

A broad array of process capabilities and vertical integration makes it possible to manufacture flexible circuits to the stringent quality standards of the medical industry, as well as other high reliability applications:

UV Yag Laser

UV Yag lasers allow for drilled holes down to .001" diameter, as well as, prototype and production outlining within .002" of existing copper features.

Automated Plated Through Hole Process

Process reliability and consistency controlled by automated PTH process.

Laser Direct Imaging (LDI)

 Laser direct imaging provides excellent circuit layer registration, with via to pad registration to +/-.001" and lines and spaces capabilities down to .001".

Additive Copper Processing

Inert anode copper plating supports nodule free copper traces down to .002" trace and space in 1 oz. thick copper with straight sidewalls.

Subtractive Copper Processing

Fine line .001" trace and space on thin copper up to .0005" thick.

Automated Optical Inspection

State of the art AOI equipment is used to confirm accuracy of copper geometry on all work in process.

Finishing Options

Soft Gold, Hard Gold, Nickel, Tin, Tin/Lead, Immersion Silver, ENIG, ENEPIG all available to support assembly process from soldering to wire bonding.

Assembly

Surface mount component package sizes down to 0201 and leaded components down to 0.4mm pitch are attached using our automated pick & place equipment. Tech Etch also offers precision single point, bar bonding, and hand assembly.

Circuit Test

Standard Opens and Shorts testing per IPC-9252 using dedicated fixtures.

- High density bare board testing achieved using flying probe (fixtureless) electrical test.
- Hipot and Insulation Resistance testing up to 16 channels.
- Impedance, Inductance and Capacitance bare board testing, as well as functional in-circuit testing of discrete components (capacitors, resistors, diodes).



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DOUBLE LAYER FLEX CIRCUIT





STAINLESS STEEL CIRCUITS



FLEX ILLUSTRATES FINE LINE AND LASER DRILLING CAPABILITY



ACTUAL SIZE .75"



| Flex Circuit Substrates |

Tech Etch typically uses polyimide film as the base layer on single metal layer flex circuits and for inner layers of multilayer circuits. Polyimide offers dimensional stability, has low moisture absorption, excellent thermal and electrical resistance, and is UL rated.

Copper is the most common metal used for circuit traces and offers the most cost effective solution. Thickness typically ranges from .0007" to .0028". Other materials can be used for specific applications such as high resistance metals (stainless steel) for heater applications, thicker copper for high power requirements, or beryllium copper for applications which require spring properties. Selective tungsten segments are used when radiopacity is required.

Adhesiveless Substrates

For applications where thinness is a concern, adhesiveless base materials can be used to further reduce the overall thickness of the flexible circuit. These materials do not have the layer of adhesive typically found between the polyimide film and copper circuitry layer. The use of these materials can reduce the thickness of the flexible circuit by approx. 001" per copper layer.

| Flex Circuit Construction |

Plated Through Vias

A via is a metalized through hole that connects the conductive layers of a flexible circuit. The drawing below illustrates the three varieties: through, blind and burried vias. Tech Etch has the ability to drill vias as small as .001" diameter using UV Yag laser technology.



Circuit Layer Geometry

Tech Etch has the ability to fabricate fine line circuit layer geometry and high density via arrays through the use of Laser Direct Imaging combined with Additive or Subtractive copper processing. The processing method for the copper layer is dictated in part by the design requirements, process capabilities, material requirements, and is usually determined by Tech Etch. Tech Etch can produce fine line circuits with trace and space patterns as small as .001" in production volumes.



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ISO9001:2015





POLYIMIDE STIFFENER



MOLDED PLASTIC STIFFENER



CANTILEVERED FINGERS



FORMED BERYLLIUM COPPER CONTACT FINGERS

ТЕСНЕТСН

Coverlayer

The insulating layer, or cover layer, is typically constructed of a precut piece of polyimide film laminated over the conductors using either acrylic or epoxy adhesive. Polyimide offers dimensional stability, has low moisture absorption, excellent thermal and electical resistance, and is UL rated.

For high density applications surface mount technology will be used for assembly, Tech Etch also has the ability to work with Photo Imageable Coverlayer. This material is coated over the conductors and does not require adhesive or lamination. Though not as resilient as polyimide film, it does support very small and dense access openings required by many of today's electronic components.

Tech Etch can register extremely small openings in Photo Imageable Coverlayer to corresponding circuit layer geometry by using Laser Direct Imaging.

Stiffener Options

Polyimide film may be used when the additional thickness required is between .002" - .009". Polyimide stiffeners can have coincidental edges to the circuit outline. Other materials such as metal or molded plastic components can also be used as stiffeners for specific flex circuit design requirements.

FR-4 is used when the additional thickness required is greater than .010". The stiffener features are typically smaller than the corresponding circuit features by .015". Applications with surface mount components typically require the use of a rigid stiffener. FR-4 can be added to the opposite side of the flex circuit to strain relieve the solder joints.

Finish Options

Exposed pads will typically need a finish for corrosion resistance or compatibility with the assembly process or application. Electroplating is the most common finishing process. Tech Etch offers in-house electroplating of Tin, Tin Lead, Copper, Nickel, Soft Gold, and Hard Gold. Electroplating can only be used when all the traces are connected to a common external plating bus during fabrication.

For designs where the traces cannot be bussed into the panel, electroless nishing options such as hot air solder leveling, ENIG (immersion gold / electroless nickel), ENEPIG (immersion gold / electroless palladium / electroless nickel), immersion silver, and immersion tin are available as alternatives.

The final finish applied to a flex circuit can be tailored to support end customer assembly process. For example, exposed pads on the flex circuits can be plated with tin to support soldering process or soft gold to support more sophisticated assembly processes like wire bonding. Because flexible circuits are sometimes used to interconnect different

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ISO13485:2016 REGISTERED









CONDUCTORS SUSPENDED IN OPEN WINDOW



CONTOURED CIRCUIT



COMPONENT ASSEMBLY



electronic modules, selective plating can be applied to the different areas of the circuit to support multiple assembly processes. This is particularly useful when multiple assembly processes will be used on the same circuit design. Tech Etch flex circuits can be made RoHS compliant by selecting the proper finish. Our product engineers will help ensure the finish selected supports the intended application.

Quality and Qualification

 Accurate dimensional inspection is supported by the use of OGP smart scopes and Keyence automatic inspection equipment, both of which use edge detection technology.

In process inspection of plating thickness is done with XRF and CMI equipment on an AQL basis.

Dedicated engineering resources and throrough understanding of PFMEA, MSA (GR&R), and statisical analysis support customer requirements for data collection and qualification reporting.

Integrated Interconnection Options

By using our unique polyimide etching technology, Tech Etch can supply circuits with conductors suspended across an open window in the polyimide film or cantilevered from the edge of the circuit, referred to as windowed leads. These traces can be directly attached to mating components using solder or wire bond process. For circuits made with beryllium copper, cantilevered leads can be formed and used as integral spring contacts.

Capitalizing on its experience with thick metal photo etching, Tech Etch can supply contoured circuits with integral contact fingers up to .010" thick. The metal in other areas of the circuit is etched down to approximately .003" thick. Particularly useful for applications where current carrying capacity is a requirement, this process also supports raised solder pads above the cover layer or circuits manufactured on material as thick as .020".

Component Assembly

Surface mount component package sizes down to 0201 and leaded components down to .4mm pitch are attached using automated solder printing, pick & place, and reflow equipment (SMT process). In addition to surface mount components, high density surface mount connectors can also be added as a way to connect the flexible circuit to the corresponding electronics.

Tech Etch also offers through hole component assembly, as well as, single point or bar bonding for applications requiring significant process control such as ACF bonding, or for specialty components such as axial lead thermistors, piezo elements, wound coil antennas, and circuit pins.



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| Flex Circuit Dimensions and Tolerances |

Optimum Sizes

Tech Etch provides circuits up to 16" long. Multi-layer circuits up to 8 conductive layers are available. Consult factory for larger sizes.

Shielding

For designs requiring shielding, additional layers of copper can be added in solid or grid patterns. Conductive ink shield layers are also available.

Flexibility

Dynamic regions on a flex circuit should be identified on the print to allow for manufacturing features that will enhance dynamic performance. The following are general guidelines that apply to non-dynamic applications where bends are for installation only.

Minimum Bend Radius

Single Layer Circuit10x thickness Multi-Layer Circuit20x thickness

Temperature

Most often the adhesive used is the limiting factor for high temperature rating continuous service. Typical values are 105C (221F) for acrylic and epoxy adhesives. Both systems will withstand normal soldering practices after a moisture driving bake.

Circuit Layer Design Guidelines

	NUMINAL		
ATRIBUTE	DETAIL	MINIMUM	PREFERRED
Line Width – Outer Layers	А	0.0015"	.002"+
Line Width – Inner Layers	В	.001"	.002"+
Line to Line Space – Outer Layers	С	0.0015"	.002"+
Line to Line Space – Inner Layers	D	.001"	.002"+
PTH Diameter – Drilled	Ø	.001" min	
PTH to PTH Pitch – Center to Center	F	ø+.0065"	ø+.0075"+
<u>PTH Pad Diameter – Outer Layer</u>	G	+.002"	ø+.003"+
PTH Internal Land Dia. – Inner Layers	Н	ø+.002"	ø+.003"+
PTH Clearance Dia. – Inner Layers	I	+.004"	ø+.005"+



Coverlayer Design Guidelines

	POLYIMIDE COVERLAY				PHOTO IMAGEABLE COVERLAY			
	NOMINAL		TOLERANCE		NOMINAL		TOLERANCE	
	MIN.	PREF.	MIN.	PREF.	MIN.	PREF.	MIN.	PREF.
FEATURE SIZE	0.008"	0.020"	±0.001"	±0.010"	0.004"	0.008"	±0.001"	±0.002"
REGISTRATION	-	-	±0.001"	±0.010"	-	-	±0.001"	±0.005"

If your design requirements exceed the capabilities stated above, please contact the factory to see if an alternate process or tooling is available.



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A TOTAL CAPABILITY

World Technology Leader

Tech Etch manufactures precision parts for the medical device and equipment, military/aerospace, electronic, telecommunications, and measurement and control industries. Tech Etch specializes in photo etching, forming and laminating engineered components, in addition to flexible circuits. The company has a long history of technological innovation, quality products, excellent customer service, and growth. From its beginnings as a research firm in 1964, Tech Etch has expanded its product offerings, acquired new businesses, and constructed new facilities. Tech Etch operates three manufacturing facilities and has over 700 employees. Corporate headquarters and most of the custom engineering and manufacturing are located in Plymouth, MA, just 40 miles south of Boston. Over 190,000 square feet of floor space, conference and training rooms, and state-of-the-art chemical processes and equipment make this Tech Etch's centerpiece. The other facilities are located in Fall River, Massachusetts and Litchfield, Minnesota.

Wide Range of Processes

Tech Etch performs a wide variety of processes, and this single-source capability enables it to assume total responsibility for the quality and delivery of our precision products. In-plant services include photo etching and chemical milling, artwork generation and phototooling, stamping from coil stock and forming from etched blanks, tool and die making, production heat treating, flexible circuit design and production, welding and soldering, metal finishing, plating, and laser cutting. Secondary operations such as soldering joints to seal seams, spot welding, and the application of pressure sensitive tapes and insulation materials are also available.

ISO 9001, ISO 13485, and AS9100D Certification

Tech Etch operates a Quality Management System that is registered to ISO 9001, ISO 13485, and AS9100D. This system is designed to control all business processes from Contract Review through the manufacturing processes to final inspection of product. The system seeks to identify and eliminate all nonconformities and prevent their recurrence through Corrective Action and Internal Auditing procedures. Process capability studies are available to guide you on part manufacturability.

Innovation Center

Tech Etch is leading the way to help facilitate you in quick prototyping by means of our state-of-the-art Innovation Center. The center is equipped with leading edge technology, an expert engineering team, and top of the line software. Tech Etch is your one stop shop to take your idea and get it to production. For more information visit techetch.com/innovation-center.

\star ADDITIONAL PRODUCTS & CAPABILITIES \star

EMI/RFI SHIELDING

Tech Etch designs and manufactures a broad line of standard and custom EMI/RFI shielding products including BeCu and wire mesh gaskets, conductive elastomers, and board level shielding. Our catalog of standard products is available online or in print.



FLEXIBLE & RIGID FLEX CIRCUITS

Tech Etch has the tools and talents required to create highly reliable flex and ridged-flex circuits for a variety of uses. We also offer SMT component assembly on these products.



PRECISION ENGINEERED PARTS

Tech Etch manufactures a wide variety of lightweight metal parts as small as .0005" in thickness. We use a photo-etching process that allows us to create intricate and detailed pieces that can't be made with other processes.

