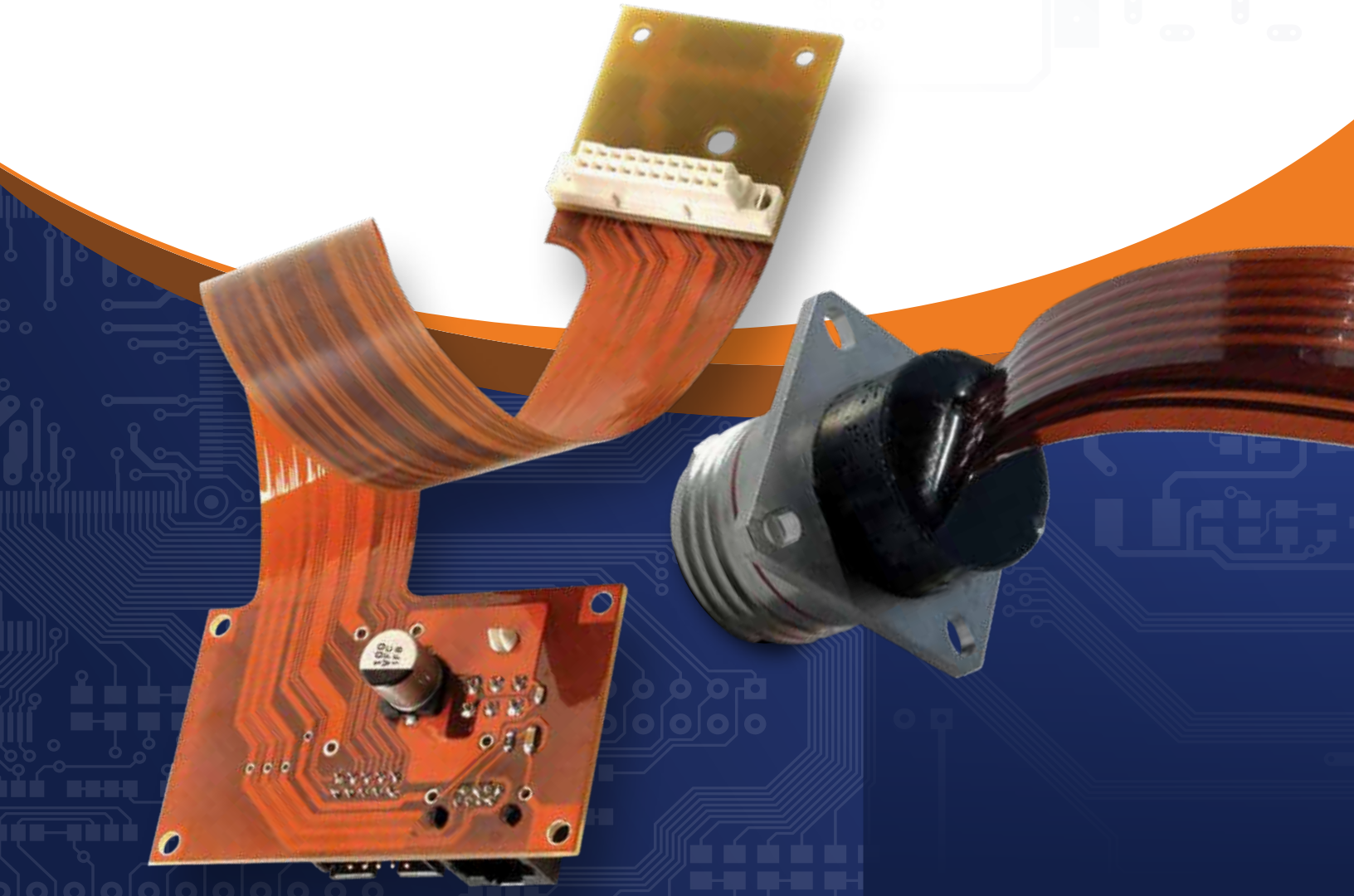
all flex
SOLUTIONS

FLEXIBLE CIRCUIT DESIGN GUIDE



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FLEXIBLE CIRCUIT DESIGN GUIDE

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BENEFITS OF FLEXIBLE CIRCUITRY

1. A SOLUTION TO A PACKAGING PROBLEM

- Flexible circuits allow unique designs which solve interconnection problems
- The ability to fold and form flex circuits enables a package size reduction
- Flex circuits make installation and repair practical and cost effective

2. REDUCE ASSEMBLY COSTS

- Flex circuits can be tested prior to assembly of components
- Reduction of connectors and solder joints lowers costs, and improve product reliability

3. REPLACEMENT FOR A CIRCUIT BOARD AND WIRES

- Flexible circuits simplify system design
- Flex reduces the number of levels of interconnection required in an electronic package
- Flexible circuits eliminate human error common in wire assemblies as routing is determined by artwork and repeatability is guaranteed

4. REDUCE WEIGHT AND SPACE

- Considerable weight reduction is a benefit over wire harnesses, and rigid assemblies
- Thickness can be as thin as .004 inches (.10mm) in total

5. DYNAMIC FLEXING

- The thinness of the material makes flexible circuitry the best candidate for dynamic flexing applications up to millions of flexures

6. THERMAL MANAGEMENT/HIGH TEMPERATURE APPLICATIONS

- Flex circuits dissipate heat at a better rate than any other dielectric materials

7. AESTHETICS

- Flex circuits improve the internal appearance of an electronic package, which can have an influence on the decision making process of prospective users of the product

DESIGN CONSIDERATIONS FOR STANDARD MANUFACTURING CAPABILITIES

CIRCUIT CONSTRUCTIONS

SINGLE-SIDED

DOUBLE-SIDED

MULTI-LAYER

RIGID FLEX

EXTENDED LENGTH MAXI FLEX

CATHETERFLEX®

SHIELDING

COPPER

TATSUTA, SILVER

STANDARD CIRCUIT SIZES

(Longer available, considered MAXI-Flex®, see page 7)

SINGLE-SIDED: *(see page 5)*
up to 22” by 28”
(558.8mm by 711.2mm)

DOUBLE-SIDED: *(see page 5)*
up to 16” by 22”
(406.4mm by 588.8mm)

MAXI-FLEX®: *(see page 7)*
up to 20” by 40’ plus
(508mm by Length)

MULTI-LAYER *(see page 6)*

12” by 24”
(304.8mm by 609.6mm)

RIGID FLEX *(see page 6)*

3-20+ Layers standard construction (depending on complexity and design)

HOLE SIZE

NON-PLATED

(Standard Processing)

THRU HOLES:

.005” (.125mm) min. drilled hole size.
Tolerance +/- .0015” (.038mm)

PLATED THRU HOLE:

.005” (.125mm) min. drilled hole size.
Tolerance +.003” (.076mm), -.005” (.125mm)

(Smaller holes can be manufactured, contact All Flex Sales)

LINE WIDTH AND SPACING

.002” (0.05mm) MINIMUM LINE

.002” (0.05mm) MINIMUM SPACING

(Finer lines can be manufactured, contact All Flex Sales.)

CIRCUIT/BLANKING CONSIDERATIONS

SOFT TOOLING:

Outline dimensions
+/- .005” (.125mm)

Radius of inside corners minimum of .023” (.584mm)

Edge insulation
.010” min (.254mm)

HARD TOOLING:

Outline dimensions
+/- .001” (.0254mm)

Edge insulation
.006” min (.152mm)

LASER CUT:

Outline dimensions
+/- .003” (.25mm)

Edge insulation
.004” (.102mm)

DRILL POSITION

Tolerance of +/- .003” (.076mm)

ZIF END TOLERANCE

+/- .002” (.0508mm) with CpK>2.0

ADDED VALUE CAPABILITIES

AUTOMATED MIXED FORM FACTOR ASSEMBLY

SURFACE MOUNT COMPONENTS

Down to 01005

Thru hole assembly
(see more on page 9)

PLACEMENT ACCURACY TO .001”

ROHS COMPLIANT ASSEMBLY

PRECISION STENCILING

HEAT SINKS

ELECTRICAL TESTING

FOLDING

FORMING

ALL FLEX CIRCUIT DESIGN AND ENGINEERING WILL BE HAPPY TO ASSIST YOU...

STANDARD MATERIALS

BASE MATERIALS

POLYIMIDE

.0005” to .005”
(.012mm - .127mm)

ADHESIVELESS MATERIALS

Copper thickness
6µ to 4 oz. (0.0056” - 0.14mm)

FLAME RETARDANT

Laminates and Coverlay

OTHER MATERIALS UPON REQUEST

BASE COPPER

6µ thick copper
9µ thick copper
.5 oz. - .0007” (.018mm) thick copper
1 oz. - .0014” (.036mm) thick copper
2 oz. - .0028” (.071mm) thick copper
3 oz. - .0042” (.107mm) thick copper
4 oz. - .0056” (.142mm) thick copper
5 oz. - .0070” (.178mm) thick copper
6 oz. - .0084” (.213mm) thick copper
7 oz. - .0098” (.249mm) thick copper

Thicker coppers are available (call for information). See current carrying chart on page 19.

SOLDER MASK

POLYIMIDE COVERLAY

.0005” to .005”
(.012mm - .127mm)

PHOTO-IMAGEABLE COVERCOAT

LPI - Liquid Photo Imagable - for high density applications.

SURFACE FINISH

HOT AIR SOLDER LEVEL (HASL)

RoHS Compliant and Tin Lead

TIN PLATING (ROHS COMPLIANT)

Electroless and electrolytic

SILVER (ROHS COMPLIANT)

Immersion

HARD GOLD OVER NICKEL (ROHS COMPLIANT)

(Typically used for contacts)

SOFT GOLD OVER NICKEL (ROHS COMPLIANT)

(Electrolytic - sometimes used for bonding gold wire to the gold layer)

ENIG (ELECTROLESS NICKEL IMMERSION GOLD) (ROHS COMPLIANT)

(Electroless - sometimes used for bonding aluminum wire to the nickel under the gold)

ENEPIG PLATING

ORGANIC COATING

OSP (RoHS Compliant)

RIGIDIZERS/STIFFENERS

FR4

drilled, routed, or scored

ALUMINUM

POLYIMIDE

STAINLESS STEEL

CERTIFICATIONS

ISO 9001:2015

ISO 9001:2023 CERTIFIED

AS9100C

MIL-P-50884E QUALIFIED

ROHS COMPLIANT

IPC MEMBER:

Product is manufactured in accordance with the requirements of IPC-6013B Classes 1, 2, 3

ITAR REGISTERED

JCP CERTIFIED

UL RECOGNIZED

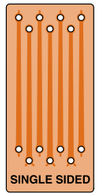
For single and double sided constructions with individual polyimide layers up to 5 mil, including several surface finishes (File # E161240)

Quotes Provided In 24 Hours

- ***E-mail: rfq@allflexinc.com***
- ***www.allflexinc.com***
- ***Call: 800.959.0865***

SINGLE-SIDED AND DOUBLE-SIDED CIRCUIT CONSTRUCTION

SINGLE-SIDED FLEXIBLE CIRCUITS



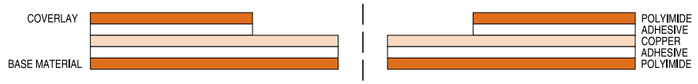
Single-sided flexible circuits consist of a single conductive layer on a flexible dielectric film (see diagram below).

SINGLE-SIDED FEATURES

- Very thin construction .004"-.008" (.10mm - .20mm)
- 1 Conductive layer
- Reverse bared or back bared pads, provide access from both sides of the part
- Supported and unsupported finger areas

WHEN TO USE SINGLE-SIDED FLEX

- Dynamic flexing applications
- Unusual folding and forming applications
- Installation/service applications/repair
- Limitations on space / thickness
- Installation / Service flexing

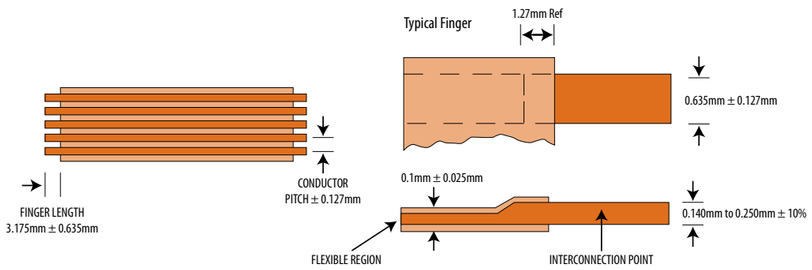


(refer to standard materials page for material availability)

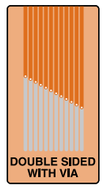
A UNIQUE TYPE OF SINGLE-SIDED CIRCUIT

SCULPTURED FLEX CIRCUITS

Sculptured flex circuits have variable copper thicknesses within the part. Thin copper is used for the flexible regions, and thicker copper is used at the interconnection point. Sculptured flex circuits provide bare metal connections and are a highly reliable alternative to mechanically crimped contact pins.



DOUBLE-SIDED FLEXIBLE CIRCUITS



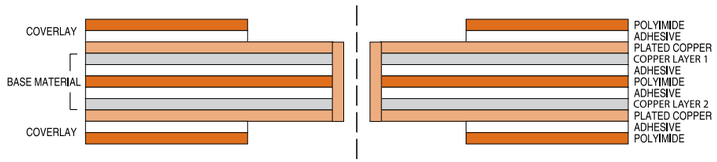
Double-sided flexible circuits consist of two conductive layers normally connected with a plated through-hole (see diagram below).

DOUBLE-SIDED FEATURES

- Component assembly available on both sides
- Two conductive layers

WHEN TO USE DOUBLE-SIDED FLEX

- Required when circuit density and layout cannot be routed on a single layer
- Ground and power plane applications
- Used for shielding applications
- Dense surface mount assembly

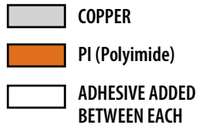


(refer to standard materials page for material availability)

MULTI-LAYER AND RIGID-FLEX CIRCUIT CONSTRUCTION

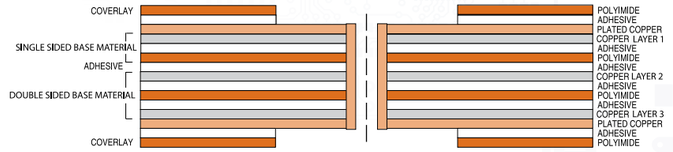
MULTI-LAYER CONSTRUCTION CIRCUITS

Controlled impedance and shielding possible.



WHEN TO USE MULTI-LAYER FLEX

- Required when circuit density and layout can not be routed on a single or double layer
- Ground and power plane applications
- Used for shielding applications
- Dense surface mount assembly
- Increased circuit density
- EMI/RFI shielding
- Controlled impedance with shielding

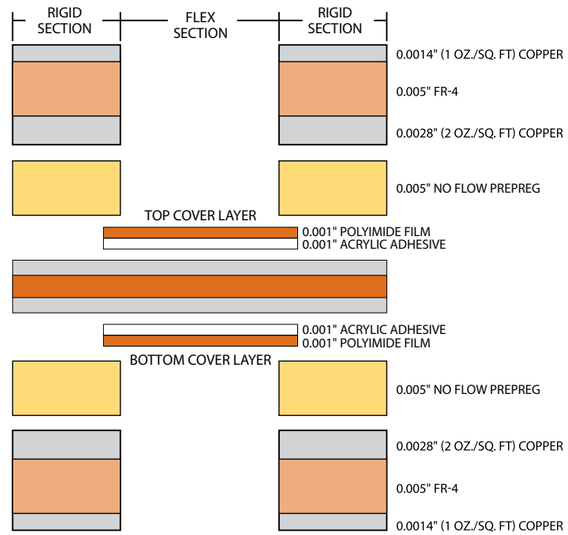


(refer to standard materials page for material availability)

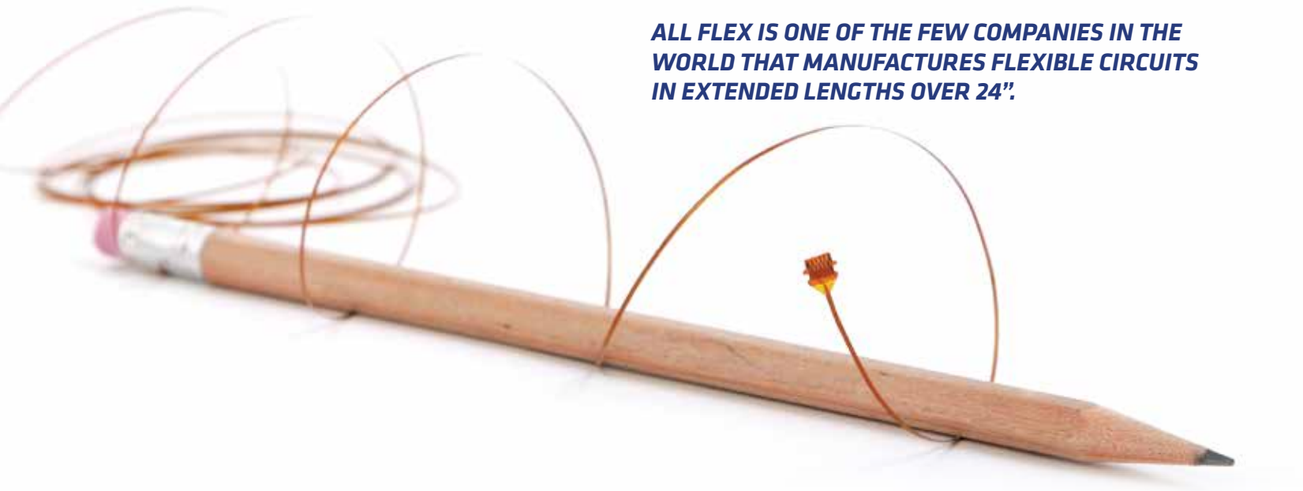
RIGID-FLEX CIRCUITS

Rigid-Flex circuits are characterized by having conductors on both the flexible and rigid layers of the circuit. Plated thru holes extend between the flexible and rigid sections and electrically connect multiple conductor layers. Rigid-flex circuits are often used when components are mounted on both sides of the rigid section. This circuit construction is known as a Type 4 circuit as defined by IPC 6013 and should be distinguished from a flexible circuit with a rigid stiffener attached.

*Ask about our **Rigid Flex Solutions Guide** and our* **Rigid Flex Design for Manufacturing Guide**



MAXI-FLEX®



ALL FLEX IS ONE OF THE FEW COMPANIES IN THE WORLD THAT MANUFACTURES FLEXIBLE CIRCUITS IN EXTENDED LENGTHS OVER 24".

MAXI-FLEX®

All Flex has trademarked our special flex circuit offering that allows an application to be produced at larger than normal sizes. Maxi-flex® is a circuit that is typically found on one or two conductive layers longer than 24" in length. Additional layers may be added.

Custom Designed Copper Flexible Circuits in exceptionally long lengths up to 40'+.

- Sizes from 2' to 40'+ by 20" max.
- Single-sided, double-sided, multi-layer
- Plated through holes
- Ideal for large systems and unmanned systems
- Permits tight bends
- Eliminates bulky cabling
- For use in military and aerospace applications
- Standard conductor pitch down to 0.030" (0.76mm) (finer pitch available, call ALL FLEX sales for more information)
- Shielding possible to provide EMI/RFI protection
- Controlled impedance design available
- Light Weight, dense packaging solutions
- Replacement for wire harnesses
- Custom termination design for use with:

High density circular connectors.

D subminiature connectors.

Surface mount connectors and components.

Pin and socket connectors.

Leaded components.

Edge card and zif connectors.

Crimp-on/displacement pins and connectors

MAXI-FLEX® circuits can be designed for specific applications with signal, power and shielding layers in one complete interconnect package.

(IMPORTANT: DUE TO MATERIAL AVAILABILITY in these lengths, contact All Flex staff for further information on standard MAXI-FLEX® construction options.)

CATHETERFLEX®

All Flex Solutions, Inc. has unique capabilities in manufacturing extended length flex circuits up to 108" (274cm) long for catheter applications. Our CatheterFlex® solution offers our medical customers an innovative and reliable option that reduces assembly cost and saves space in catheter applications. Reduce assembly time and increase throughput by replacing bulky wire bundles with easy to string and assemble CatheterFlex® Circuits from All Flex.

Whether you are reimagining an existing design to reduce cost or designing a new catheter and have limited space, these cutting-edge circuits from All Flex have you covered. Some applications include:

- Diagnostic Catheters with multiple electrodes
- Pulsed-Field Ablation Catheters with multiple electrodes
- IVUS catheters
- Intra-Cardiac Echocardiology (ICE) Catheters requiring a large number of transducers
- Endoscopes
- Thermal/Cryoablation Catheters where temperature sensing is critical

All Flex has the capability to build CatheterFlex® long and narrow flexible circuits with very fine features that extend the entire length of your catheter. Below is a list of the benefits CatheterFlex® solutions offer our customers:

- Replace bulky wires with a single CatheterFlex® solution
- Reduce assembly time by up to 90%!!!
- Easy to string into catheters
- Fewer connections/solder joints (eliminate interconnects in the distal end)
- Reduce rework and misconnections
- Higher electrode density
- Improved reliability
- Controlled impedance for increased yield over hand soldered designs
- Shielding for EMI/RFI protection
- Incorporate etched Type T thermocouple(s) for temperature sensing

This Product Information Sheet provides CatheterFlex® circuit capabilities to help with your design.

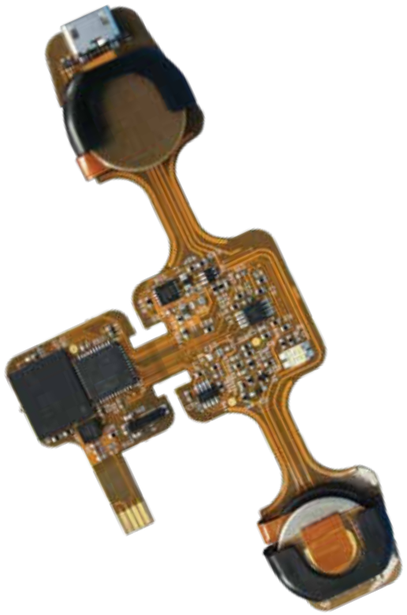
Quotes Provided In 24 Hours

- ***E-mail: rfq@allflexinc.com***
- ***www.allflexinc.com***
- ***Call: 800.959.0865***

ALL FLEX ADDS VALUE

MAXI-FLEX®

All Flex has the capability to quickly design, manufacture and deliver in volumes from prototype to production. All Flex has manufactured hundreds of designs for the military, medical and industrial markets.

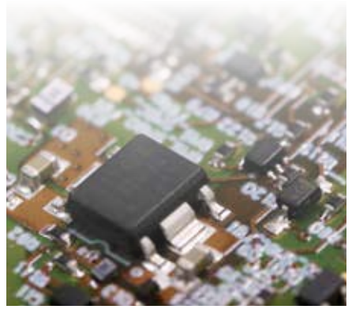


HAND ASSEMBLY

- Operators certified to J-STD
- Lead and lead free capability
- ESD controls

AUTOMATED PICK AND PLACE CAPABILITY PROVIDES COMPLEX ASSEMBLY COMBINATIONS INCLUDING

- Surface mount components down to 01005
- Precise vision system allows placement accuracy to .001”
- Fine pitch capability to .5mm pitch
- Leaded devices
- Tactile domes
- Staked terminals
- Unlimited component configurations
- RoHS Compliant assembly
- Virtually all SMT components including discretes, SOICs, PLCCs, QPPs, & BGA’s
- Auto fiducial correction



AUTOMATED ASSEMBLY

Solder Screener

- Automated screening of solder onto arrays/panels using solder stencil
- Lead and lead free capability

Selective Soldering

- Automated ability to solder leads on through hole connector
- Lead and lead free capability

OTHER ALL FLEX ADDED VALUE CAPABILITIES

- Thru hole assembly
- Flexible circuit folding and forming (see page 12)
- Electrical testing
- Heat Sinks
- Nomenclature Screening
- Stiffener placement
- Design and manufacturing support – concept to completion

CIRCUIT TESTING CAPABILITY

- Solderability
- Ionic contamination
- Dimensional tolerance
- Thermal testing
- Dielectric net-to-net
- Insulation resistance (IR)
- Microsections
- Continuity
- Inductance
- Capacitance
- Resistance
- Impedance

POTTED CIRCUITS

Connector securely adhered with potting compound to perform in rugged applications where vibration is typical.

SURFACE DIELECTRICS OPTIONS

Surface dielectrics are applied to the outside layers of the circuit to insulate the copper conductors.

Following are types of surface dielectrics used at All Flex.

POLYIMIDE COVERLAY

Coverlay is a polymer film coated with a thermoset adhesive. These materials are normally machined and shaped with a drilling process. Drilling limits the shapes available on coverlay features. Coverlay can be punched or blanked in lieu of the drilling process and is normally done for large coverlay openings.

VIA HOLE

Plated thru hole generally covered with coverlay.

COMPONENT HOLE

.010” (.254mm) minimum larger than the copper pad.

FEATURE DEFINITION

.008” (.20mm) minimum.

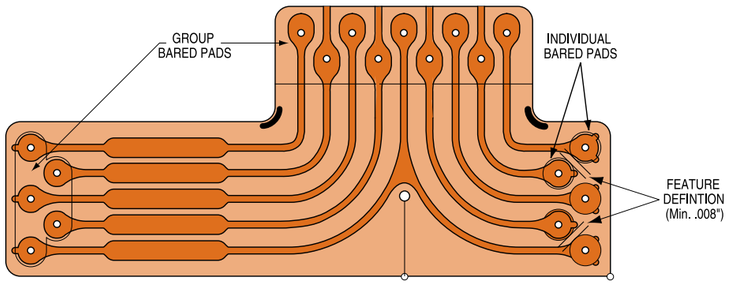
LIQUID PHOTOIMAGEABLE SOLDERMASK

Liquid Photoimageable Soldermask (LPI) is produced by a photo lithography process and used to precisely locate the dielectric on the flex circuit features. This process enables unique openings to be applied anywhere on the circuit. LPI is usually not used with 2oz. copper or above due to the thickness of the copper as it may not conform around the area of some copper features.

VIA HOLE

Plated thru hole generally covered with soldermask.

LPI Opening =.006” minimum larger than:
- pad with .004” minimum
- web spacing



Note: Coverlay openings can be individual bared pads or group bared pads depending on area available.

Note: Group bared pads are used when there is not enough room to have individual openings.

SURFACE DIELECTRICS OPTIONS

Liquid Photoimageable Soldermask (LPI)	
ADVANTAGES	DISADVANTAGES
Higher pattern resolution	Not recommended for dynamic flex applications
Eliminates punching and drilling of access holes	Less robust mechanically

Polyimide /Polyester Coverlayer Films	
ADVANTAGES	DISADVANTAGES
Excellent dynamic flexibility	Adhesive may be susceptible to cleaning solvents
Pinhole free	Requires pre-cutting and/or pre-punching
Highest dielectric strength	Susceptible to misregistration/ dimensional change

Quotes Provided In 24 Hours

- ***E-mail: rfq@allflexinc.com***
- ***www.allflexinc.com***
- ***Call: 800.959.0865***

DESIGN GUIDELINES:
CONDUCTOR PAD DESIGN AND FILLETING

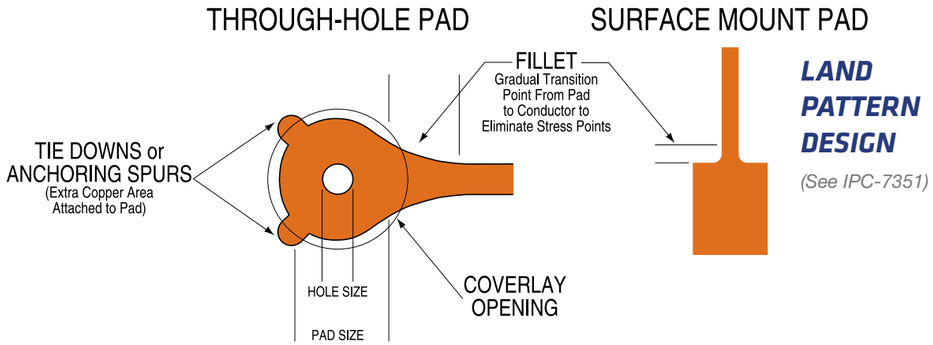
This section of our guide addresses rules specifically pertaining to conductor and pad design recommendations. Due to the flexible nature of the material during both manufacturing and application use, the following information is recommended to produce the highest yielding and best functioning flexible circuit. We call this “flexizing” the design. All Flex will flexize the conductor pattern on all part numbers to incorporate these reliability and manufacturability enhancements.

CONDUCTOR PAD DESIGN

Pads should have tie-downs (also called anchoring spurs or rabbit ears). Tie-downs are captured by the coverlay to anchor the copper to prevent separation between the copper and the base material during assembly.

FILLETING

All pads, on both through-hole and surface mount pads, should be filleted to reduce stress points. This helps eliminate breaking during flexing.

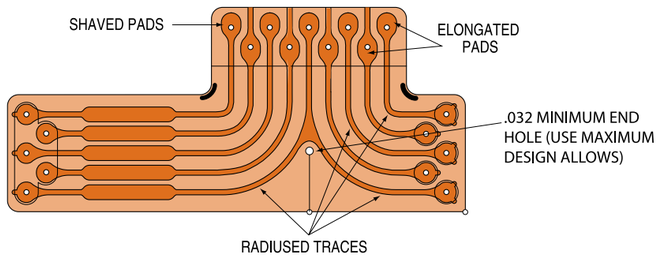


LAND PATTERN DESIGN

(See IPC-7351)

CALCULATING PAD SIZE

Recommended pad size is dependent on the component pad requirement that is specific to your application.

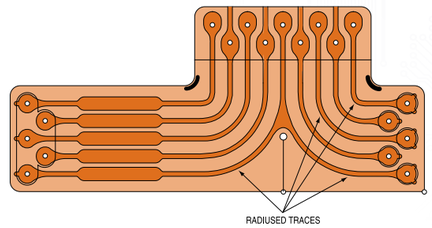


FORMULA:

HOLE SIZE (FINISHED) + CUSTOMER REQUIRED TOLERANCES + ALL FLEX TOLERANCE = PAD SIZE REQUIRED

.030” (.76mm) ±.003” (.07mm) .020” (.50mm) .053” (1.34mm)

DESIGN GUIDELINES:
TO INCORPORATE IN BENDING AND FOLDING DESIGNS

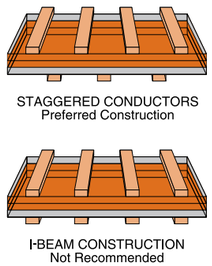


RADIUSED TRACES

Radiused Traces help to alleviate breaking during folding and bending.

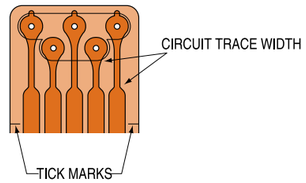
I-BEAM

I-Beam constructions occur when the conductors on both layers lie directly on top of each other, increasing the stiffness of the circuit through fold areas. A better alternative is to stagger conductors, alternating their location to retain the maximum flexibility of the circuit.



FOLD LINES

Fold lines may be designated by “tick” marks which may be either in the copper layers or silkscreen layers. These features aid in bending and designating bend locations.



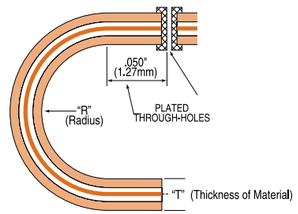
CIRCUIT TRACE WIDTH

Circuit trace width should not change in bend areas and the transition should be at least .030” (.76mm) from the fold line.

BEND RADIUS

Bend RaDius of a flex should be approximately 10 times the material thickness and at least .050” away from the plated through hole.

r=10 x T



BUTTON PLATING /PADS ONLY PLATING

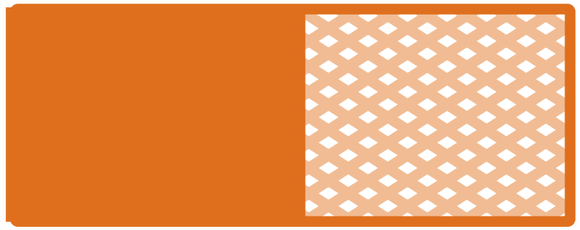
This is a process that allows for the plated through holes to maintain their connection while the traces are not plated, allowing the circuit to have increased flexibility.

Quotes Provided In 24 Hours

- **E-mail: rfq@allflexinc.com**
- **www.allflexinc.com**
- **Call: 800.959.0865**

SHIELDING

If your application requires limits in electromagnetic and/or electrostatic interference, shielding may be required. Shields are material around a conductor or group of conductors that limit these factors.



SOLID COPPER

Solid Copper is the most common method of shielding. Solid copper shields increase the rigidity of the circuit, and should be included in thickness to bend radius ratios. Copper shield can be put on one or both sides of the circuit. Solid copper can also cover selective conductors.

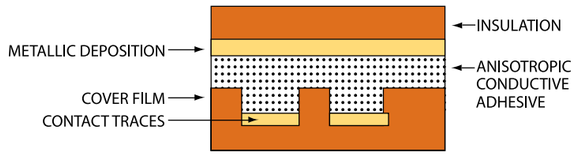
CROSSHATCHED COPPER

Crosshatching is an artwork design that relieves much of the copper shield areas by the use of a pattern. Crosshatching helps the circuit to retain its flexibility and can be put on one or both sides. Crosshatch shielding can also cover selective conductors.

Note: Additional shielding options exist, such as shielding between circuit conductor. Contact All Flex Staff for further details.

CONDUCTIVE SILVER

Conductive silver can be substituted for the copper for shielding purposes in some applications. Silver shielding is not recommended for a dynamic flexing application due to its brittle characteristic, and may be prone to cracking in severe bending applications. Silver can be a solid or crosshatched shield and can be put on one or both sides of the circuit. It can also cover selected conductors only.



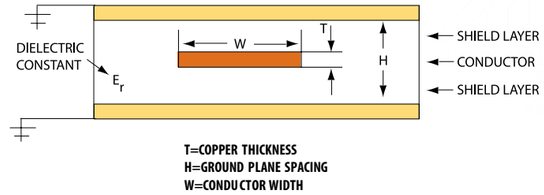
CONDUCTIVE SHIELDING FILM

Metalized film with a conductive adhesive coating is thermally bonded to flexible circuitry. Selective openings in the coverlay film allow the conductive adhesive to electrically contact the flex circuit. This creates a shielding layer by the contact between the metalized film and the ground traces.

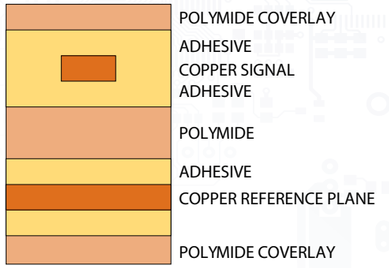
CONTROLLED IMPEDANCE

Controlled impedance is important in high speed digital circuitry to avoid signal reflectance and power loss. The impedence of a flexible printed circuit depends on dielectric constant of the base material, conductor width, conductor thickness and dielectric thickness.

STRIPLINE



SINGLE ENDED MICROSTRIP



FLEXIBLE POLYIMIDE CIRCUIT – IMPEDANCE REFERENCE CHART

Single Ended Microstrip				
MATERIAL THICKNESS INCLUDING ADHESIVE	TRACE WIDTH FOR 50 OHMS IMPEDANCE 1/2 OZ COPPER	TRACE WIDTH FOR 50 OHMS IMPEDANCE 1 OZ COPPER	TRACE WIDTH FOR 75 OHMS IMPEDANCE 1/2 OZ COPPER	TRACE WIDTH FOR 75 OHMS IMPEDANCE 1 OZ COPPER
0.002	0.0036	0.0032	0.0015	>.001
0.003	0.0057	0.0053	0.0025	0.0013
0.004	0.0078	0.0074	0.0035	0.0028
0.005	0.0102	0.0096	0.0050	0.0041
0.006	0.0122	0.0117	0.0060	0.0050
0.007	0.0144	0.0139	0.0070	0.0060
0.008	0.0166	0.0161	0.0080	0.0068
0.009	0.0189	0.0184	0.0088	0.0085
0.010	0.0211	0.0206	0.0105	0.0095

All calculations assume .002 thick coverlayer, 3.4 dielectric constant and 50% trace/ 50% space on differential pairs

RIGIDIZERS/STIFFENERS

Often circuit applications require support in areas where connectors or other components are applied. Here are the recommended types of guidelines for stiffeners.

FR4/G10 STIFFENERS

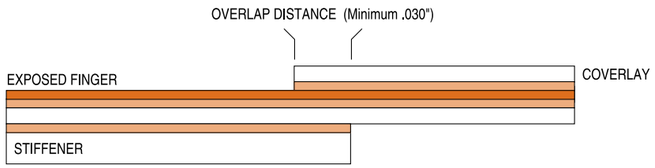
- Come in a variety of thicknesses such as .010” (.25mm), .020” (.50mm), .031” (.78mm), .047” (1.19mm) and .062” (1.57mm)
- Can be bonded to a flex circuit using a pressure sensitive adhesive or a thermoset adhesive
- Are normally used to give added rigidity under a component area
- Used as a carrier panel for automated assembly processing
- Hole size in the stiffener should be .015” (.38mm) larger than the circuit thru-hole to allow for registration tolerances

POLYIMIDE STIFFENERS

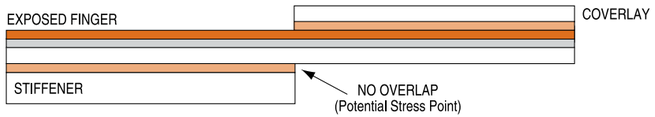
- Come in a variety of thickneses from .001” (.02mm) up to .015” (.38mm) or higher
- Can be bonded to a flex circuit using a pressure sensitive adhesive or a thermal set adhesive
- Can be used to give added thickness under conductors to meet ZIF connector requirements
- Can be used to give added strength in high wear areas
- Can be blanked at the same time as the circuit outline to meet tight tolerance requirements

LOCATION OF STIFFENER

Stiffener and coverlay termination points should overlap a minimum of .030” (.76mm) to avoid stress points. Eliminating stress points reduce the chance of traces breaking.



(This is the PREFERRED METHOD because there is not common ending point of the coverlay and stiffener.)



(This form is NOT RECOMMENDED because it allows potential stress andcracking points where the coverlay and stiffener end at a common edge.)

TERMINATION METHODS

There are many ways to terminatea flexible circuit. Following are common methods for consideration.

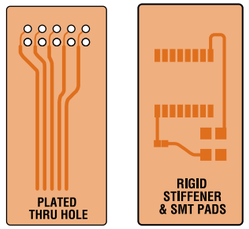
ZIF CONNECTORS

Zero Insertion Force connectors are a popular method to terminate a flexible circuit. ZIF connector fingers on the flex circuit insert into a mating connector. The ZIF end inserted into the connector are usually located on a rigid board.

Blank tolerance +/-.002”

THRU-HOLE OR SURFACE MOUNT CONNECTORS

These are the traditionally used connectors in today’s circuit boards.

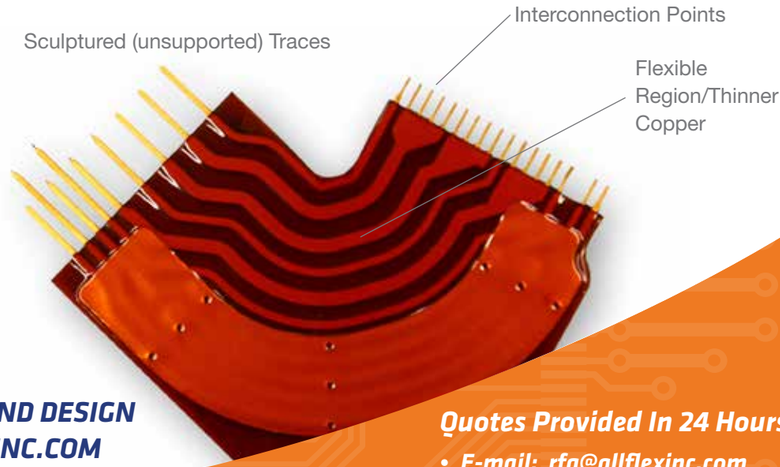


CRIMPED CONTACTS AND DISPLACEMENT CONNECTORS

- Contacts crimp through the dielectric material into the copper conductor
- Contacts are available for .100” (2.54mm) or .050” (1.27mm) centers
- Centerline housings are also available to encapsulate the contact

SCULPTURED (UNSUPPORTED) TRACES AND POWER FLEX

- Thicker copper allows flexible circuit designs to carry higher current through small spaces
- Selective etching allows a reduction in copper thickness in selective areas for increased flexibility
- Copper thickness from 0.003” (0.076mm) to 0.010” (0.254mm)



ADDITIONAL CUSTOM TERMINATION OPTIONS

- High density circular connectors
- D subminiature connectors
- Pin and socket connectors
- Leaded components

RECOMMENDED SUPPLIERS LIST FOR FLEXIBLE CIRCUIT CONNECTORS:

1. Digi-Key (800) 344-4539 www.digikey.com
2. NAC Semi (866) 651-2901 www. nacsemi.com
3. Samtec (800) 726-8329 www.Samtec.com
4. TTI (800) 225-5884 www.TTIInc.com

REQUEST QUOTES, SAMPLES, AND DESIGN CONSULTS ONLINE AT ALLFLEXINC.COM

Quotes Provided In 24 Hours

- **E-mail: rfq@allflexinc.com**
- **www.allflexinc.com**
- **Call: 800.959.0865**

ADDITIONAL TECHNICAL INFORMATION

IPC INFORMATION

The following list contains the IPC specifications that you can reference in regards to specific materials, design, performance and assembly questions.

MATERIALS

IPC-4202
Flexible Base Dielectrics

IPC-4203
Adhesive Coated Dielectric Films

IPC-4204
Flexible Metal-Clad Dielectrics

IPC-4101
Rigid PC Board Materials

DESIGN

IPC-FC-2221
Generic Standard on Printed Circuit board Design

IPC-FC-2222
Rigid Circuit Boards

IPC-FC-2223
Flexible Circuits

PERFORMANCE

IPC-6011
Generic Performance Specifications for Printed Circuits

IPC-6012
Qualification and Performance for Rigid Circuit Boards

IPC-6013
Qualification and Performance for Flexible Circuits

CIRCUITS AND ASSEMBLY (QUALITY GUIDELINES)

IPC-A-600
Acceptability of Printed Boards

IPC-A-610
Acceptability of Printed Board Assemblies

IPC/EIA J-STD001
Requirements for Soldered Electrical & Electronic Assemblies

Visit the IPC web site at www.ipc.org

Check out the online design course: www.designingflexiblecircuits.com

It's self paced and free. The course material is divided into several chapters of solid technical information about flexible circuit materials, constructions and design layout conventions. It allows designers, or engineers an opportunity to self-educate about flexible circuits.

ALL FLEX IS AN ACTIVE, AWARD WINNING IPC MEMBER HOLDING CHAIR POSITIONS ON THE FLEXIBLE CIRCUIT MATERIALS COMMITTEE

TYPICAL PROPERTIES OF DIELECTRIC MATERIAL FOR FLEXIBLE PRINTED CIRCUITRY

PROPERTY (TYPICAL)	UNITS	POLYMIDE	POLYMIDE (Adhesiveless)
REPRESENTATIVE TRADE NAME		KAPTON	KAPTON
PHYSICAL			
Thickness Range	mil	0.5 to 5	1-6
Tensile Strength (@25° C)	psi	25,000	50,000
Break Elongation	%	70	50
Tensile Modulus (@25° C)	100,000 psi	4.3	.7
Tear Initiation Strength	lb/in	1000	700-1200
Tear Propagation Strength	g/mil	0.0184	0.0088
CHEMICAL			
Resistance to:			
Strong Acids		Good	Good
Strong Alkalis		Poor	Good
Grease and Oil		Good	Good
Organic Solvents		Good	Good
Water		Good	Good
Sunlight		Good	Good
Fungus		Non-nutrient	Non-nutrient
Water Absorption (ASTM D570)	% (24 hours)	2.9	0.8
THERMAL			
Service Temperature (min/max)	degree C	-125/+200	-125/+200
Coefficient of Thermal Expansion (@22° C)	PPM/degree C	20	20
Change in Linear Dimensions (100° C, 30 min)	%	<0.3	0.04-0.02
ELECTRICAL			
DIELECTRIC CONSTANT (ASTM D150) 1MHz		3.4	3.4
DISSIPATION FACTOR (ASTM D150) 1MHz		0.01	0.003
DIELECTRIC STRENGTH (ASTM D149) @ 1 mil thickness Volume Resistivity (ASTM D257)	V/mil ohm-cm	6000 1.0E+16	6000 1.0E+16

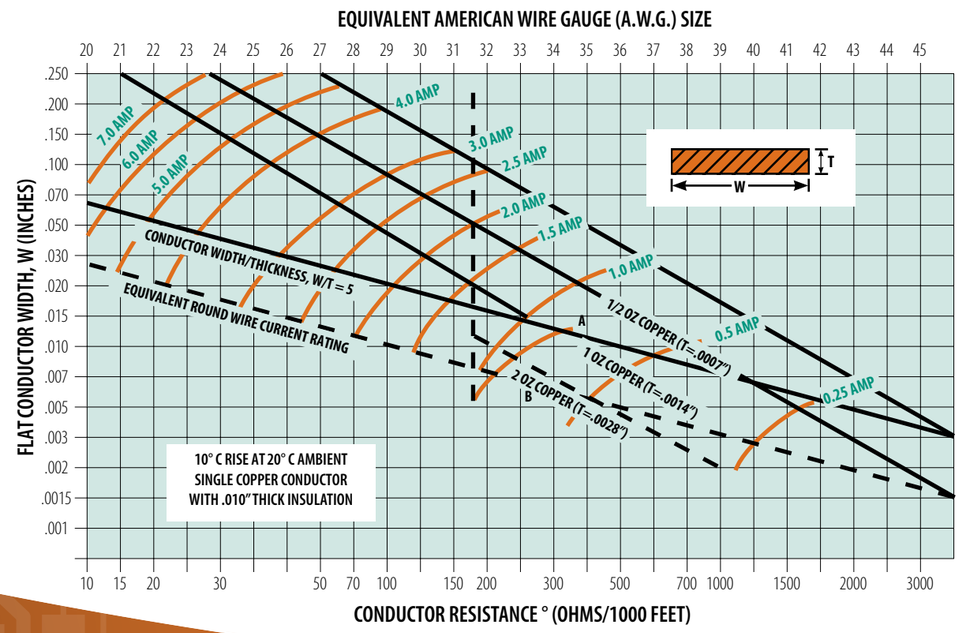
CURRENT CARRYING CAPABILITIES FOR EXTERNAL TRACES IN AIR

COPPER WEIGHT								
AMPS	1/2 OZ. (.0007")	1 OZ. (.0014")	2 OZ. (.0028")	3 OZ. (.0042")	4 OZ. (.0056")	5 OZ. (.007")	6 OZ. (.0084")	8 OZ. (.0112)
CONDUCTOR WIDTH IN INCHES								
0.5	.013"	.008"	N/A	N/A	N/A	N/A	N/A	N/A
1.0	.028"	.017"	.013"	N/A	N/A	N/A	N/A	N/A
1.5	.040"	.027"	.020"	N/A	.012"	.005"	.003"	N/A
2.0	.053"	.040"	.030"	.0235"	.020"	.018"	.016"	.013"
2.5	.080"	.060"	.042"	.0325"	.0285"	.024"	.023"	.018"
3.0	.100"	.083"	.057"	.045"	.0387"	.035"	.030"	.024"
4.0	.160"	.120"	.088"	.066"	.055"	.048"	.043"	.037"
5.0	.225"	.158"	.118"	.09"	.074"	.065"	.059"	.048"
6.0	.285" (off chart)	.195"	.153"	.117"	.094"	.082"	.074"	.062"
7.0	N/A (off chart)	.250"	.187"	.145"	.124"	.105"	.0905"	.075"
8.0	N/A (off chart)	.307"	.232"	.180"	.1485"	.130"	.122"	.095"

This chart gives recommendations for width of conductor needed to carry current on different copper thicknesses.
For informational purposes only.
Additional helpful link: http://circuitcalculator.com/wordpress/2006/01/31/pcb-trace-width-calculator/

CURRENT RATING NOMOGRAPH

Relation between current rating and size of a single conductor for constant temperature rise in air. Conductor dimensions above the line "WIDTH/ THICKNESS = 5" are preferred for ease of manufacture.



COMPUTER AIDED DESIGN (CAD) INFORMATION

DATA FORMATS

RS 274X (Gerber)

PDF

dwg

IGES

DXF

TO COMMUNICATE

BY E-MAIL
General Mailbox:
information@allflexinc.com

Call ALL FLEX
engineering toll free at
877-663-7162

README FILE SHOULD

- Contain your company name
- Contain a list of included files and their functions
- Contain your company contact and phone number

INFORMATION CAN BE RECEIVED IN A NUMBER OF WAYS

- Mechanical print/sketches
- Schematic drawings
- Component Specifications
- Request a quote: **rfq@allflexinc.com**

DESIGN: ALL FLEX OFFERS THE FOLLOWING DESIGN OPTIONS FOR OUR CUSTOMERS

- Reverse engineering of existing parts, design from concept, or design from schematic
- Gerber creation: Contact ALL FLEX sales for more information
- Critique of customers design for flexibility and manufacturability

Quotes Provided In 24 Hours

- ***E-mail: rfq@allflexinc.com***
- ***www.allflexinc.com***
- ***Call: 800.959.0865***

GLOSSARY

Annular Ring
That portion of conductive material completely surrounding a hole.

Artwork
An accurately-scaled configuration that is used to produce the "Artwork Master" or "Production Master."

Back -Bared Land
A land in flexible printed wiring that has a portion of the side normally bonded to the base dielectric material exposed by a clearance hole.

Base Film
The film that is the base material for the flexible printed wiring board and on the surface of which the conductive pattern can be formed. When the heat resistance is required, polyimide film is mostly used.

Blanking
Cutting a sheet of material into pieces to the specified outline.

Bondstrength
The force perpendicular to a board's surface required to separate two adjacent layers of the board, expressed as force per unit area.

Characteristic Impedance
The resistance of a parallel conductor structure to the flow of alternating current (AC), usually applied to high speed circuits, and normally consisting of a constant value over a wide range of frequencies.

Circuitry Layer
A layer of printed board containing conductors, including ground and voltage planes.

Clearance Hole
A hole in a conductive pattern that is larger than and coaxial with a hole in the base material of a printed board.

Conductive Foil
A sheet of metal that is used to form a conductive pattern on a base material.

Connector
A device used to provide mechanical connect/disconnect service for electrical terminations.

Copper Weight
The mass of copper per unit area for a foil, typically expressed in ounces per square foot or grams per square centimeters (these units are not equivalent).

Covercoat
Material deposited as a liquid onto the circuitry that subsequently becomes a permanent dielectric coating.

Coverlay
The layer of insulating film and adhesive that is applied totally or partially over a conductive pattern on the outer surfaces of a printed board.

Crosshatching
The breaking up of large conductive areas by the use of a pattern of voids in the conductive material.

Delamination
A separation between plies within a base material, between a base material and a conductive foil, or any other planar separation within a printed board.

Dielectric
A material with a high resistance to the flow of direct current, and which is capable of being polarized by an electrical field.

Dry Film Resist
A composite material where a photosensitive emulsion that is sensitive to portions of the light spectrum and is either carried by or sandwiched between polymer release films and is used to expose imagery on printed boards.

ENIG
Electroless Nickel Immersion Gold used as surface treatment for soldering and electrical contact.

ENEPIG
Electroless nickel, electroless palladium, immersion gold. Often used in higher reliability applications and is ideal in soft gold wire bonding applications.

Etching
The chemical, or chemical and electrolytic, removal of unwanted portions of conductive or resistive material.

Exposure
The process of generating a pattern within a photosensitive material through a chemical reaction using either laser direct imaging or conventional imaging with a working phototool.

Fiducial
A printed board feature (or features) that is (are) created in the same process as the conductive pattern and that provides a common measurable point for component mounting with respect to a land pattern or land patterns.

Flexize
Modification of an artwork to optimize manufacturability and reliability of the conductor trace pattern.

FR4
Epoxy based hardboard material used to make stiffeners.

Gerber Data
Most common PCB electronic data format. Consists of aperture selection and operation commands and dimensions in X- and Y-coordinates.

Land
A portion of a conductive pattern usually used for the connection and/or attachment of components.

Laser Direct Imaging (LDI)
The selective exposure of patterns onto a photosensitive material (such as dry film or liquid) without using a working phototool (artwork master).

Minimum Annular Ring
The minimum ring of metal(s) at the narrowest point between the edge of a hole and the outer edge of a circumscribing land. (This determination is made to the drilled hole on internal layers of multilayer printed boards and to the edge of the plating on external layers of multilayer and double-sided printed board).

Moisture
Absorption The amount of water the base material will absorb.

Pads Only Plating
A process with copper plated only in thru holes and on pads. Used to reduce thickness and increase flexibility and with controlled impedance requirements. Also referred to as button plating.

Panel Plating
The plating of an entire surface of a panel including holes.

Pattern Plating
The selective plating of a conductive pattern and associated holes.

Photoimaged Soldermask
Produced by a photo controlled process and used for tight pad spaces. This process enables unique openings to be applied anywhere on the circuit.

Photoresist
A photo-chemically reactive material, which polymerizes upon exposure to ultraviolet energy at a given wavelength customarily used to define an etching, plating, or selective stripping pattern on a substrate.

Polyimide
The synthetic polymer that has more than two imide radicals in the main chain. DuPont trademark is Kapton®.

PSA
Pressure Sensitive Adhesive.

Rolled Annealed
Copper rolled foil to a predetermined thickness and then treated through an annealing process.

Shielding, Electronic
A physical barrier, usually electrically conductive, that reduces the interaction of electric or magnetic fields upon devices, circuits or portions of circuits.

Silkscreen
A process for applying nomenclature legend.

Stiffener Board
A material fastened to the surface of a printed board to increase its mechanical strength.

Via
A plated-through hole that is used as an interlayer connection, but in which there is no intention to insert a component lead or other reinforcing material.

Source for most terms: "Terms and Definitions for Interconnecting and Packaging Electronic Circuits" IPC-T-50

all flex
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Rigid Flex Center of Excellence
1200 W 96th St
Bloomington, MN 55431

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