TABLE OF CONTENTS

BENEFITS OF FLEXIBLE CIRCUITRY

1. A SOLUTION TO A PACKAGING PROBLEM.

- Flexible circuits allow unique designs which solve interconnection problems.
- The formability of 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.
- Elimination of connectors and solder joints reduce costs.

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.
- Thickness can be as thin as .004 inches (.10mm) in total.

5. DYNAMIC FLEXING.

- The thinness of the material makes flexible circuits the best candidate for flexible 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 while providing the added benefits of vastly improved flexibility.

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.

8. FLEXIBLE HEATER CIRCUITS.

- Flexible heater circuits can be designed to provide a specified thermal output and operate in extreme temperature conditions.

Flexibility to meet customers needs

FOR STANDARD MANUFACTURING CAPABILITIES

(inquire within about nonstandard sizes)

CIRCUIT CONSTRUCTIONS:

SINGLE-SIDED

DOUBLE-SIDED

3-6 LAYERS

COPPER AND/OR SILVER SHIELDING

CIRCUIT SIZES:

SINGLE-SIDED:
up to 22" by 28"
(558.8mm by 711.2mm)

DOUBLE-SIDED:
up to 16" by 22"
(406.4mm by 588.8mm)

MAXI-FLEX®:
up to 16" by 40' plus
(254mm by Length)

FLEXIBLE HEATER CIRCUITS:

22" by 28"
(558.8mm by 711.2mm)

Engineered to meet specified output

Component and connector assembly

Soldered wire assembly for connections

MULTI-LAYER:

12" by 24"
(304.8mm by 609.6mm)

RIGID FLEX:

3-6 Layers standard construction

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)

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

LINE WIDTH AND SPACING:

.005" (.125mm) MINIMUM LINE

.005" (.125mm) MINIMUM SPACING

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

CIRCUIT/BLANKING CONSIDERATIONS:

SOFT TOOLING:

Outline dimensions
+/- .05" (.127mm)

Radius of inside corners minimum of
.032" (.081mm)

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 UP TO 0204**
- **PLACEMENT ACCURACY TO .001"**
- **RoHS COMPLIANT ASSEMBLY**
- **PRECISION STENCILING**
- **HEAT SINKS**
- **ELECTRICAL TESTING**
- **FOLDING FORMING**
- **THRU HOLE ASSEMBLY**

(see more on page 10)

Circuit Design and Engineering support will ASSIST YOU

STANDARD MATERIALS

BASE MATERIALS:

Polyimide:
.5 mil to 5 mils
(.012mm - .127mm)

Polyester:
2 mil to 15 mils
(.050mm - .127mm)

Adhesiveless Materials:
Copper thickness
.5 oz. to 2 oz.

Flame Retardant:
Laminates and Coverlay

LCP

Other Materials Upon Request

BASE 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 20.

SOLDER MASK:

Polyimide coverlay:
.5 mil to 5 mils
(.012mm - .127mm)

Polyester coverlay:
1.5 mil to 3 mils
(.076mm - .228mm)

Photo-imageable covercoat:
Liquid for Surface Mount and dense 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- typically used for bonding gold wire to the gold layer)

ENIG (Electroless Nickel Immersion Gold) (RoHS Compliant)
(Electroless- typically used for bonding aluminum wire to the nickel under the gold)

Organic Coating
OSP (RoHS Compliant)

RIGIDIZERS/STIFFENERS:

FR4-drilled, routed and scored

Aluminum

Polyimide

Polyester

Stainless Steel

CERTIFICATIONS:

ISO 9001: 2008 Certified

AS9100 Certified

MIL-P-50884D Qualified

QS 9000 Compliant

RoHS Compliant

IPC MEMBER: Product is manufactured in accordance with the requirements of IPC-6013

ITAR Registered

JCP Certified

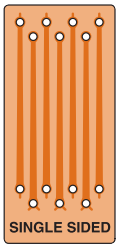
UL Certified for individual polyimide layers up to 3mil (not multi-layers)

For screen silver shielding

Flexibility to meet customers needs

SINGLE-SIDED & DOUBLE-SIDED CIRCUIT CONSTRUCTION

SINGLE-SIDED FLEXIBLE CIRCUITS



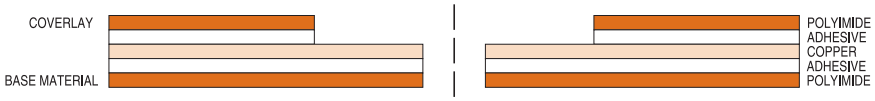
Single-sided flexible circuits consist of a single copper conductor layer on a flexible dielectric film (see diagram below). Single-sided circuits can be fabricated with or without coverlayers.

SINGLE-SIDED FEATURES:

- Very thin construction under .004"-.008" (.10mm - .20mm)
- 1 Conductive Layer.
- Reverse bared or back bared pads.
- 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

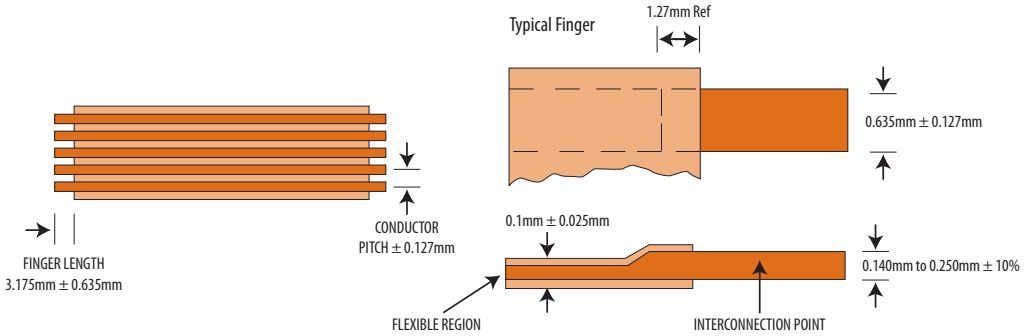


(refer to standard materials page for material availability)

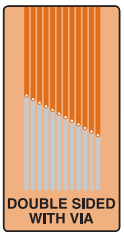
A UNIQUE TYPE OF SINGLE SIDED CIRCUIT

SCULPTURED FLEX CIRCUITS

Sculptured flex circuits have variable copper thicknesses. 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



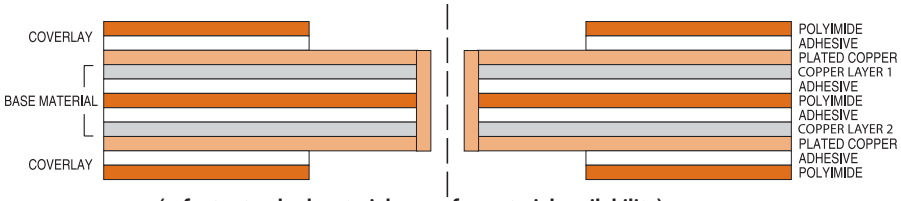
Double-sided flexible circuits consist of two copper layers encapsulated with dielectric, normally connected with a plated through-hole (see diagram below). Double-sided circuits can be fabricated with or without coverlayers.

DOUBLE-SIDED FEATURES:

- Component assembly available on both sides.
- Two conductive layers.
- Fingers are an integral part of the conductor patterns. (call for details or sample)

WHEN TO USE DOUBLE-SIDED FLEX:

- Required when circuit density and layout can not 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 & RIGID-FLEX CIRCUIT CONSTRUCTION

MULTI-LAYER CONSTRUCTION CIRCUITS

• Controlled impedance and shielding possible.

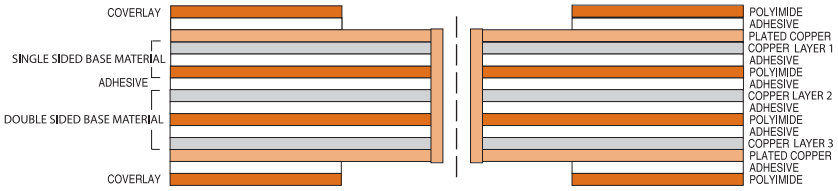
COPPER

PI

ADHESIVE ADDED BETWEEN EACH

WHEN TO USE MULTI-LAYER FLEX:

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

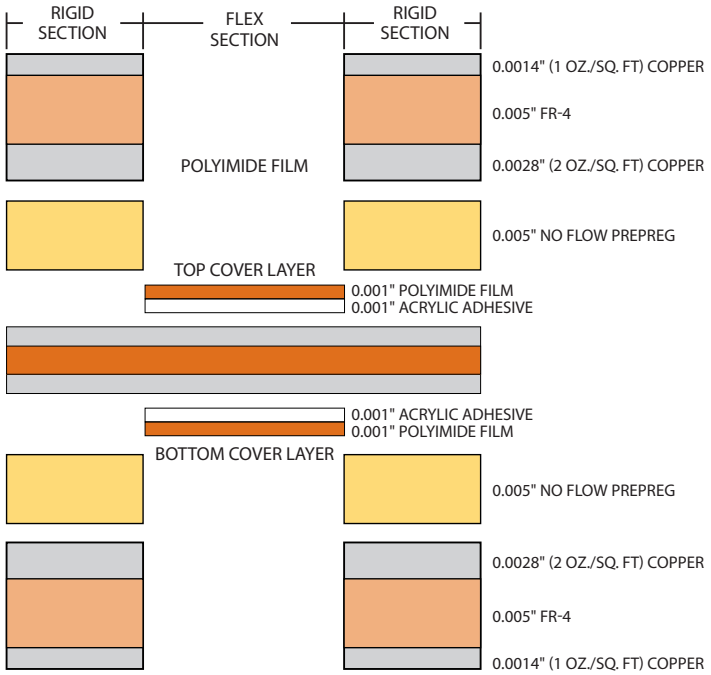


(refer to standard materials page for material availability)

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.

Inquire Within



Flexibility to meet customers needs

MAXI-FLEX®

All Flex has trade marked our special flex circuit offering that allows an application to be produced at larger than normal sizes. MAXI-FLEX® is a circuit that is normally found on one or two conductive layers longer than 24" in length. Additional layers may be added using an IPC type 5 construction. Following is information regarding MAXI-FLEX® circuits.

MAXI-FLEX®

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

- Sizes from 2' to 40'+ by 16" max
- Standard conductor Pitch Down to 0.030" (0.76mm) (Finer pitch available, call ALL FLEX sales for more information)
- Shielding to provide EMI/RFI Protection
- Controlled Impedance Design
- 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 & Components
  - Pin and Socket Connectors
  - Leaded Components
  - Edge Card and ZIF Connectors
  - Crimp-On/Displacement Pins and Connectors

MAXI-FLEX® is designed for your specific application 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.)

FLEXIBLE HEATER CIRCUITS

All Flex can reverse engineer, design and fabricate flexible heaters to meet customer's exact requirements. Flexible polyimide heaters and heater assemblies are fabricated with a variety of metal alloys to deliver custom solutions for heating capacity, watt density, and other application specific customer needs. Typical lead times 2 – 3 weeks upon customer approval.

FLEXIBLE HEATER CIRCUIT FEATURES:

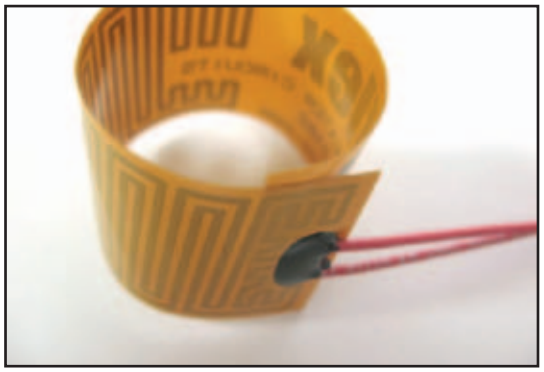
- Temperatures up to 260°F (127°C)
- Circuit size up to 10" x 22" (558.8mm x 711.2mm)
- Resistant to most chemicals
- Engineered to meet specified output
- Flexible Heaters can be supplied as thin as 4 mils
- Component and connector assembly
- Soldered wire assembly for connections
- Epoxy reinforced soldered wires

APPLICATIONS FOR FLEXIBLE HEATER CIRCUITS:

- Ruggedized electronic and computer devices made to operate in extreme weather conditions
- Medical instrumentation and laboratory equipment
- Aerospace and military aircraft equipment
- Battery heaters to enhance battery performance
- General industrial and instrumentation applications

OTHER CONSIDERATIONS:

- Thermistor Assembly
- Epoxy coated for environmental resistance
- Heater can be built with multiple temperature zones
- Quick Turn Available
- Any Volume Quantities
- Assembly expertise

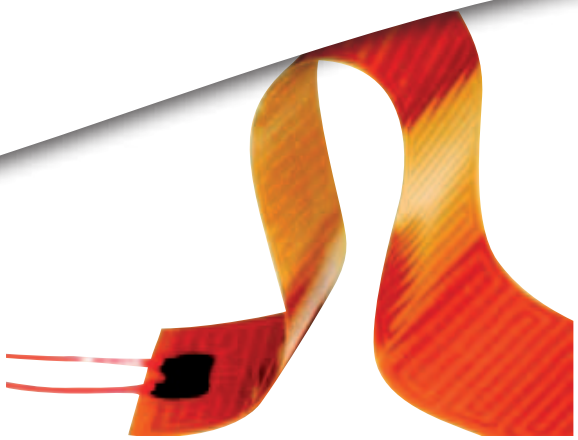


Thin and flexible heaters can wrap and bend providing uniform heat

All Flex can
REVERSE ENGINEER
to meet exact requirements

Flexibility to meet customers needs

FLEXIBLE & HYBRID HEATER CIRCUITS



All Flex engineering will work closely with you to ensure the proper design and layout. We can also reverse engineer existing designs. The following are typical characteristics and parameters of our heater circuit products.

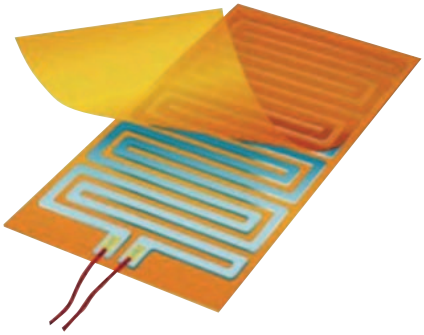
DESIGN PARAMETERS

CHARACTERISTICS	TYPICAL PARAMETERS
Size Range	Less ½" square up to 10"X 22"
Temperature Range	80 deg – 250 deg f
Resistance Range	5 ohms – 250 ohms
Metal Thickness Range	.0005-.002
Total Thickness Range	.0045 - .015 w shielding
Dielectric Range /Insulation Resistance	Same as flex circuits (FR)
Power Requirements	2.5 w/in2 –low end, 5w/in2 – all purpose, 10w/in2 -rapid warm up
Resistance Tolerance	+/- 10%
Voltage	12 v up to 115 v
Coverlay thickness	1 or 2, 3 and 5 mil
Leads (if required)	Length/Awg/coating

FLEXIBLE HEATER HYBRID CIRCUITS

Now your single or double sided circuit assembly can have built-in heaters.

All Flex can take your electronic circuitry requirements and your heat requirements and create a hybrid product. Typically the heater functionality is on one side of the base film and the electronics functionality is on the opposite side. By combining a copper layer for the electronics with a layer of resistive metal for the heater, a hybrid circuit can be designed. Top to bottom electrical connection can be done with plated thru holes. All Flex has unique process and materials that can accommodate even the most challenging hybrid requirements. All Flex can handle multiple plated metals and combine layers by a number of via plating processes.

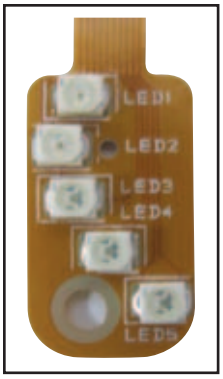


ADVANTAGES OF A HEATER HYBRID CIRCUIT

- Thinner overall profile
- Reduces overall Assembly Weight
- More robust functionality
- Lower over all costs

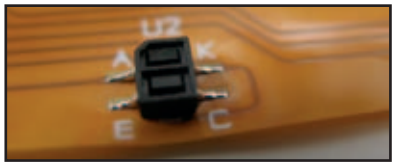
ALL FLEX ADDS VALUE

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



AUTOMATED PICK AND PLACE CAPABILITY PROVIDES COMPLEX ASSEMBLY COMBINATIONS INCLUDING:

- Surface mount components down to 0204
- 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



OTHER ALL FLEX ADDED VALUE CAPABILITIES

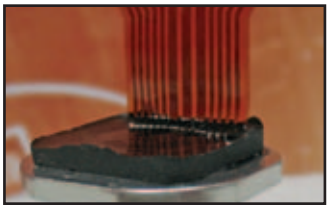
- Thru hole assembly
- Flexible circuit folding and forming (see page 13)
- Electrical testing
- Heat Sinks
- Nomenclature Screening
- Stiffener placement
- Design and manufacturing support – concept to completion

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



Flexibility to meet customers needs

COVERLAY OPTIONS

Coverlay is a material applied to the outside layers of the circuit to insulate the copper conductor.

Following are types of coverlays used at All Flex.

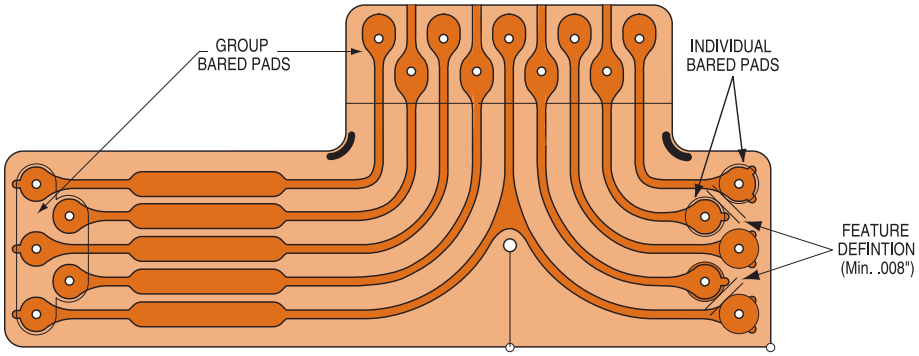
POLYIMIDE/POLYESTER COVERLAY

These materials are normally produced with a drilling process. Limitations to the drilling process enable production of round and oval holes, leaving the inability to have square openings, dense features or any unique shape other than round or oval. Both polyester and polyimide coverlay can be punched or blanked in lieu of the drilling process and is normally done for large coverlay openings.

VIA HOLE:
Covered with coverlay

COMPONENT HOLE:
.010" (.25mm) minimum larger than the copper pad

FEATURE DEFINITION:
.008" (.20mm) minimum



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.

PHOTO-IMAGEABLE COVERLAY

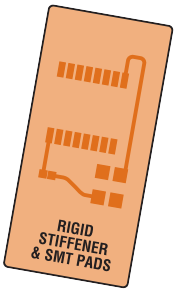


Photo-imageable coverlay (LPI) is produced by a photo controlled process and are used for tight pad spaces. This process enables unique openings to be applied anywhere on the circuit. LPI is usually not used with 2oz. copper or above due to the thickness of the copper as it may not conform around the area of some copper features.

VIA HOLE:
Covered with soldermask

LPI Opening =.006" minimum larger than pad with .004" minimum web spacing

CONDUCTOR PAD DESIGN AND FILLETING

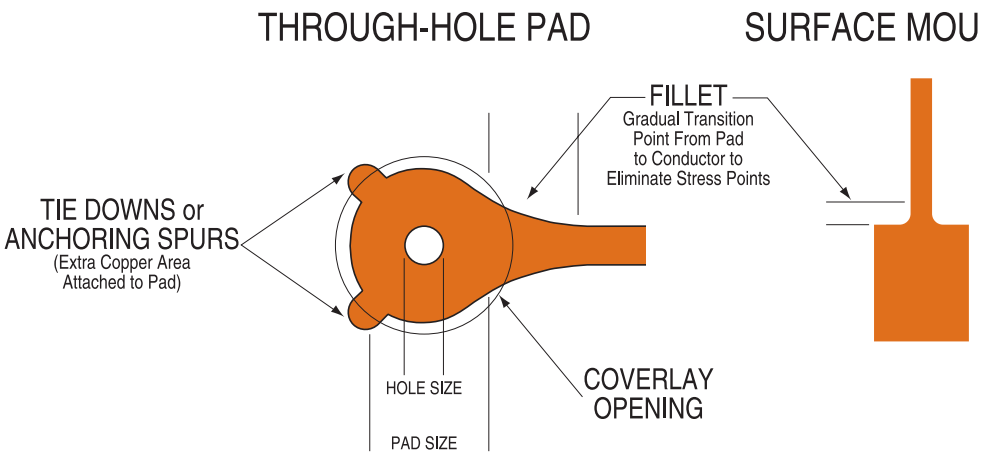
This section of our guide addresses rules specifically pertaining to conductor and pad design recommendations. Due to the flexible nature of the material during both manufacturing and application use, the following information is recommended to produce the highest yielding and best functioning flexible circuit.

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.

FILLETING:

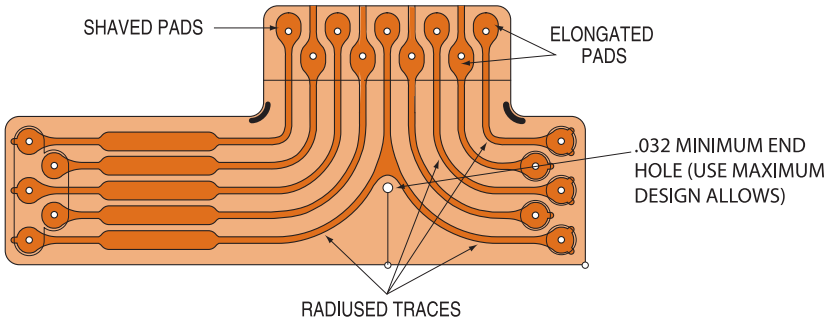
All pads, on both through-hole and surface mount pads, should be filleted to reduce stress points. This helps eliminate breaking during flexing.



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.



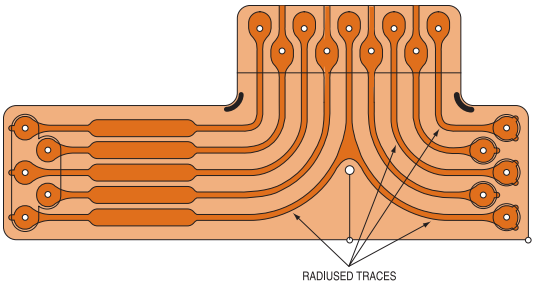
FORMULA:

HOLE SIZE (FINISHED)	+	CUSTOMER REQUIRED TOLERANCES	+	ALL FLEX MANUFACTURED FACTOR	=	PAD SIZE REQUIRED
.030" (.76mm)		±.003" (.07mm)		.020" (.50mm)		.053" (1.34mm)

Flexibility to meet customers needs

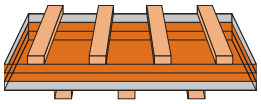
DESIGN GUIDELINES:

TO INCORPORATE IN BENDING AND FOLDING DESIGNS

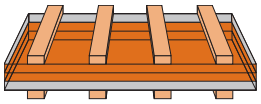


RADIUSED TRACES help to alleviate breaking during folding and bending.

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.

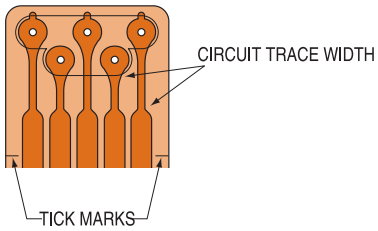


STAGGERED CONDUCTORS
Preferred Construction



I-BEAM CONSTRUCTION
Not Recommended

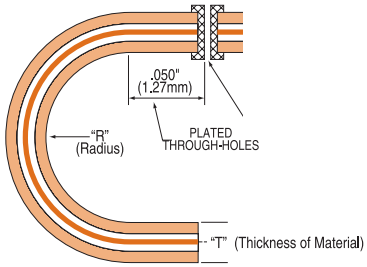
FOLD LINES may be designated by "tick" marks which may be either in the copper layers or silkscreen layers. These features aid in bending and designating bend locations.



CIRCUIT TRACE WIDTH should not change in bend areas and the transition should be at least .030" (.76mm) from the fold line.

BEND RADIUS of a flex should be approximately 10 times the material thickness and at least .050" away from the plated through hole.

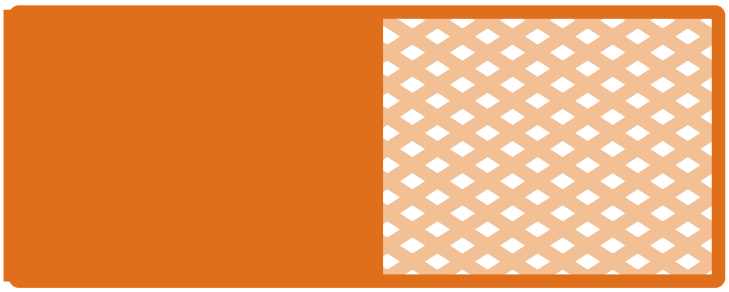
r=10 x T



BUTTON PLATING/PADS ONLY PLATING 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.

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 review. 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.

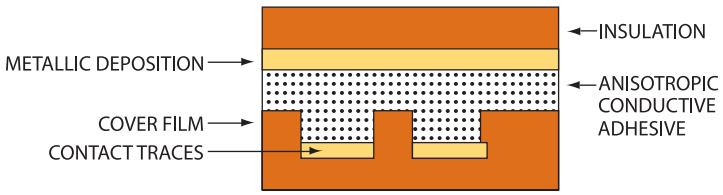
Note: Additional shielding options exist, such as shielding between circuit conductor. Contact All Flex Staff for further details.

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.



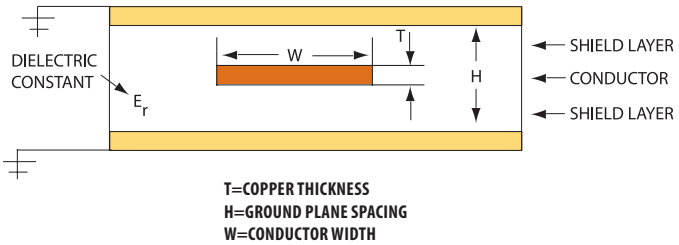
Flexibility to meet customers needs

SHIELDING

CHARACTERISTIC IMPEDANCE:

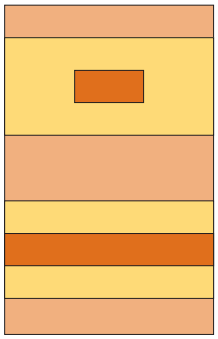
Controlled impedance is important in high speed digital circuitry to avoid signal reflectance and power loss. The impedence of a flexible printed circuit depends on dielectric constant of the base material, conductor width, conductor thickness and dielectric thickness.

STRIPLINE



T=COPPER THICKNESS
H=GROUND PLANE SPACING
W=CONDUCTOR WIDTH

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:

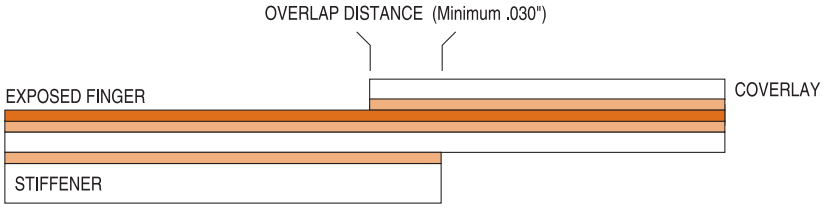
- Come in a variety of thicknesses such as .010" (.25mm), .020" (.50mm), .031" (.78mm), .047" (1.19mm) and .062" (1.57mm).
- Can be bonded to a flex circuit using a pressure sensitive adhesive or a thermalset adhesive.
- Are normally used to give added rigidity under a connector area.
- Used as a carrier 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 OR POLYESTER STIFFENERS:

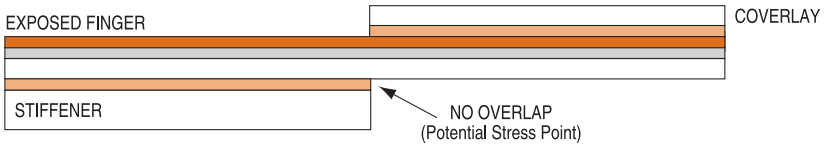
- Come in a variety of thicknesses from .001" (.02mm) up to .015" (.38mm) or higher.
- Can be bonded to a flex circuit using a pressure sensitive adhesive or a thermal set adhesive.
- Can be used to give added thickness under conductor fingers to meet ZIF connector requirements. .
- Can be used to give 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 and cracking points where the coverlay and stiffener end at a common edge.)

Flexibility to meet customers needs

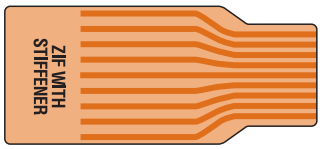
TERMINATION METHODS

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

ZIF CONNECTORS:

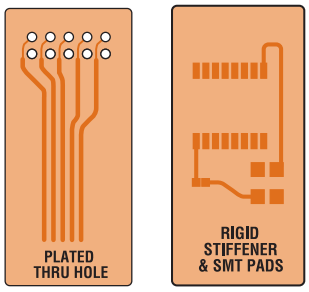
Zero Insertion Force connectors are becoming an increasingly popular method to terminate a flexible circuit. Use of a ZIF connector eliminates the need for a mating connector. The flex end "mates" into the connector usually located on the rigid board.

Blank tolerance +/-.002"



THRU-HOLE OR SURFACE MOUNT CONNECTORS:

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

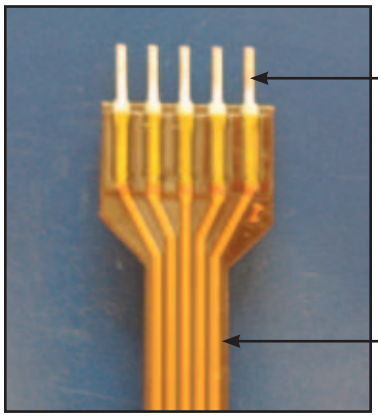


CRIMPED CONTACTS AND DISPLACEMENT CONNECTORS:

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

SCULPTURED (UNSUPPORTED) FINGERS AND POWER FLEX:

- Thicker copper allows flexible circuit designs to carry higher current through smaller 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)



Sculptured Fingers

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. Heilind Electronics (866) 286-0322 www.Heilind.com
2. Samtec (800) 726-8329 www.Samtec.com
3. Digi-Key (800) 344-4539 www.digikey.com
4. Sager Electronics (800) 724-3780 www.sager.com

REQUEST quotes, samples, and design consults online
www.allflexinc.com

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

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 @ www.ipc.org

Flexibility to meet customers needs

ADDITIONAL TECHNICAL INFORMATION

TYPICAL PROPERTIES OF DIELECTRIC MATERIAL FOR FLEXIBLE PRINTED CIRCUITRY

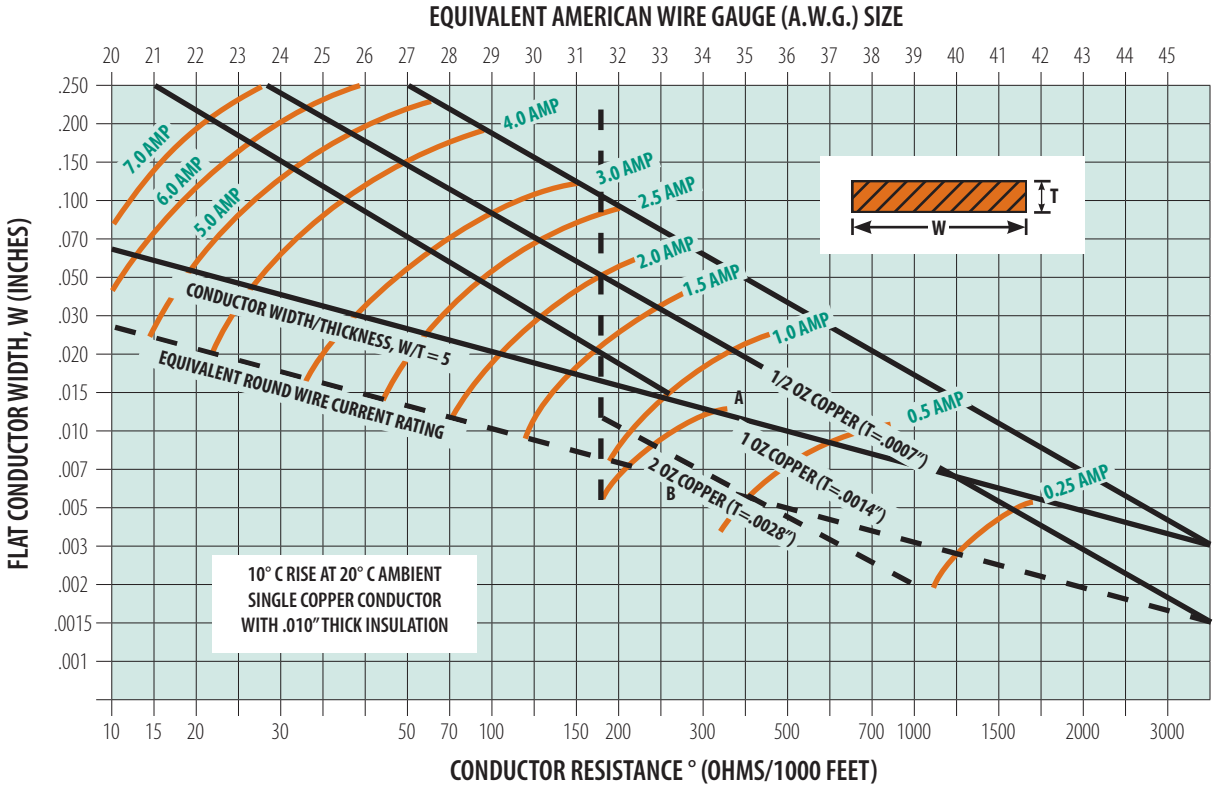
PROPERTY (TYPICAL)	UNITS	POLYIMIDE	POLYIMIDE (Adhesiveless)	POLYESTER
REPRESENTATIVE TRADE NAME		KAPTON	KAPTON	MYLAR
PHYSICAL				
Thickness Range	mil	0.5 to 5	1-6	2-5
Tensile Strength (@25° C)	psi	25,000	50,000	20,000 to 35,000
Break Elongation	%	70	50	60 to 165
Tensile Modulus (@25° C)	100,000 psi	4.3	.7	5
Tear Initiation Strength	lb/in	1000	700-1200	1000 to 1500
Tear Propagation Strength	g/mil	8	20	12 to 25
CHEMICAL				
Resistance to:				
Strong Acids		Good	Good	Good
Strong Alkalis		Poor	Good	Poor
Grease and Oil		Good	Good	Good
Organic Solvents		Good	Good	Good
Water		Good	Good	Good
Sunlight		Good	Good	Fair
Fungus		Non-nutrient	Non-nutrient	Non-nutrient
Water Absorption (ASTM D570)	% (24 hours)	2.9	.8	<0.8
THERMAL				
Service Temperature (min/max)	degree C	-125/+200	-125/+200	-60/+105
Coefficient of Thermal Expansion (@22° C)	PPM/degree C	20	20	27
Change in Linear Dimensions (100° C, 30 min)	%	<0.3	0.04-0.02	<0.5
ELECTRICAL				
DIELECTRIC CONSTANT (ASTM D150) 1MHz		3.4	3.4	3
DISSIPATION FACTOR (ASTM D150) 1MHz		0.01	.003	0.018
DIELECTRIC STRENGTH (ASTM D149) @ 1 mil thickness Volume Resistivity (ASTM D257)	 V/mil ohm-cm	 6000 1.0E+16	 6000 1.0E+16	 3400 1.0E+16

CURRENT CARRYING CAPABILITIES:

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.

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.

Flexibility to meet customers needs

COMPUTER AIDED DESIGN (CAD) INFORMATION

DATA FORMATS:

[PREFERRED FORMAT]

Customer Prints
Circuit Data
Drill Data
Route Data
Netlist Data
RS 274X / DXF
RS 274X
Excellon 2
Excellon
IPC-D-356

[ACCEPTABLE FORMAT]

AutoCAD.dwg
GDSII
IGES
DXF
HPGL
HPGL2
Orbotech 5000 Backup
IPC-D-350
Barco DPF
CSI Autoplot
TrudnI
Hitachi 1
Hitachi 2
Sieb & Meyer
Posalux

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
- Existing Artwork to be Scanned
- Fax (507) 663-1070
- E-mail (information@allflexinc.com)
- Secure FTP: ftp://mail.allflexinc.com (contact us for password)
- Request a quote: rfg@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.

We provide **QUOTES** in 24 hours

GLOSSARY

BREAK ELONGATION

The increase in length of a material, caused by a tensile load, which causes the material to break.

COMPARE THERMAL PROPERTY SPECIFICS TO FR4

FR4 is a NEMA designation for flame retardant epoxy resin woven glass reinforced laminate. This laminate is copper clad for producing "rigid board" printed circuitry. FR4 has glass transmission temperatures ranging from 110° Celsius to 180° Celsius. FR4 is a common stiffener material for flexible printed circuits because it has similar thermal characteristics to polyimide/acrylic/copper clad laminates.

DIELECTRIC CONSTANT

The property of a dielectric which determines the electrostatic energy stored per unit volume for a unit potential gradient.

DIELECTRIC STRENGTH

The maximum voltage that a dielectric can withstand, under specified conditions, without resulting in a voltage breakdown (usually expressed as volts/unit dimension).

DIMENSIONAL STABILITY

A measure of the dimensional change of material that is caused by factors such as temperature changes, humidity changes, chemical treatment (aging) and stress exposure.

DISSIPATION FACTOR

A value that represents the tendency of insulating or dielectric materials to absorb some of the energy in an alternating–current signal.

EDHD VS. H.T.E. COPPER

EDHD copper is electro-deposited high ductility copper designed for flexible circuits where some flexing will occur in use or moderate stress is expected. EDHD is generally less expensive than rolled annealed copper. H.T.E. copper is high temperature elongation copper designed for applications where stress or flexing will occur at elevated temperatures.

FATIGUE DUCTILITY

A value of the ductility determined by continuous flexing of copper conductors versus to ductility determined by elongation testing.

MOISTURE ABSORPTION

The amount of water the base material will absorb.

RESISTIVITY

A material's opposition to the flow of electric current, measured in ohms.

RoHS

Restriction of Hazardous Substances. RoHS, also known as Directive 2002/95/EC, originated in European Union and restricts the use of specific hazardous materials found in electrical and electronic products. Restricted materials mandated under RoHS are: lead (Pb), mercury (Hg), cadmuim (Cd), hexavalent chromium (CrVI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).

TENSILE STRENGTH

The resistance of a material to a force tending to tear it apart, measured as the maximum tension the material can withstand without tearing.

THERMAL RESISTANCE

Resistance to heat.

THERMOPLASTIC VS. THERMALSET

Thermoplastic adhesives are adhesives that become fluid above their glass transition temperatures and can be re-melted repeatedly. Thermalset adhesives are those that cure with cross-linking between the polymer chains and will not re-melt with repeated heating.

TIE COAT

Used to improve the bond of copper to polyimide film and provide a barrier to copper oxidation. The "tie coat" is Chrome or Monel sputtered or vapor deposited on to the polyimide film prior to the copper deposition.

ULTIMATE ELONGATION

The maximum increase in length of a material prior to breaking.

Flexibility to meet customers needs