Multilayer Technology
Providing Solutions to Board Fabrication Challenges

Military/Defense
RF Microwave
Aerospace
Medical
ATE
Telecom
Instrumentation
Oil & Gas Exploration

multilayer.com
Multilayer Technology

An AS9100C & ISO 9001 Company

Established in 1986  Made in the USA
Multilayer Technology is a full service PCB provider specializing in high quality, high density, quick turn fabrication for time-critical solutions.
CERTIFICATIONS

• AS9100C Certified Company
• ISO 9001:2008 Certified Company
• MIL-PRF-55110 Certified GFN (FR4) & GIN (Poly) w/Etchback.
• ITAR Registered
• SDB (Small Minority-Owned Business) CCR registered business.
• IPC-6012 (Rigid) Class 1, 2 & 3
• IPC-6013 (Flex) Class 1, 2 & 3
• IPC-6018 (Microwave) Class 1, 2 & 3
Management Info System

- State-Of-The-Art computer network & MIS systems.
- Bacon Software: Automated JQS (Job Quoting System) - Sales Order - Change Order - JTS (Job Tracking System - true real-time barcode tracking system for orders)
- Inside Sales Support
COMPANIES WE WORK WITH

- Northrop Grumman
- NASA
- Raytheon
- General Dynamics
- DRS Technologies
- Schlumberger
- Sandia National Laboratories
- IFSI
- Halliburton
- Texas Instruments
- Cobham
- Jacobs
- Oceaneering

3835 West Conflans, Irving, Texas 75061
sales@multilayer.com | Call Us at (972)790-0062 | Fax (972)-790-0293
COMPANIES WE WORK WITH (continued).
Multilayer Technology supplies complex PCBs to Jacobs Engineering for assembly and delivery. The programs supported are some of the most critical at NASA and most deal with advanced space applications, including:

- Robonaut (99% supplier of electronics systems);
- International Low Impact Docking System (iLIDS) for the International Space Station;
- Simplified Aid for Extravehicular Activity (EVA);
- SAFER (Rescue System);
- Project V;
- ISS Safer Avionics; and
- DARPA Robotics Challenge (DRC).

Click to read more...

WWW.MULTILAYER.COM

3835 Conflans Rd
Irving, TX 75061-3914
(972) 790-0062
Technologies

- Multilayer up to 48 layers
- Flex and Rigid-Flex
- Double-sided
- Blind/Buried vias (mechanical & laser drilling)
- RF Microwave - Teflon (Rogers / Taconic / Arlon) 2 - 20 layers
- Controlled impedance (Polar Instruments)
- Mix Dielectrics
- SMT & BGA (Surface Mount Technology & Ball Grid Array)
Technologies (continued)

- Plugged vias (Soldermask, Non-Conductive Epoxy, Conductive Copper & Silver Epoxy Filled)
- Aspect ratios to 15:1
- Lines and spacing down to 4 mils (3 mils design review req’d)
- Drill capabilities down to 6 mils
- Scoring - V groove jump scoring
- Backdrilled Via’s
<table>
<thead>
<tr>
<th>Layer Count</th>
<th>Standard</th>
<th>Advanced</th>
<th>Emerging</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-48 Layers</td>
<td>2-48 layers</td>
<td>50+ Layers</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Laminate Materials</th>
<th>Isola</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
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<tbody>
<tr>
<td></td>
<td>TUC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Panasonic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Ventec</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Nelco</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Polyimide</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Rogers</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Taconic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>RoHS Materials</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Halogen Free</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Aluminum Backing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Brass Backing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Copper Backing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Bergquist</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Laird</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>C-LEC Plastic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Flex Substrates</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<table>
<thead>
<tr>
<th>Board Types</th>
<th>Rigid</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Rigid-Flex</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Flex</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td></td>
<td>RF Microwave</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Mix Dielectrics</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Dielectrics With Metal Core/Backing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel Sizes</th>
<th>Standard Panel</th>
<th>Non-Standard Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 X 18</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>16 X 18</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>16 x 21</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>18 X 24</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>21 x 24</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>22 x 28</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

** Panel Utilization Can Vary On Panel Area Depending On Design, IPC Coupons & TDR Coupons.**

<table>
<thead>
<tr>
<th>Material Thickness</th>
<th>Standard Panel</th>
<th>Non-Standard Panel</th>
<th>Advanced Panel</th>
<th>Emerging Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish Thickness</td>
<td>.003&quot; to .200&quot;</td>
<td>.003&quot; to .500&quot;</td>
<td>&gt; .500</td>
<td></td>
</tr>
<tr>
<td>Minimum Core Thickness</td>
<td>0.002</td>
<td>0.002</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Finished Thickness Tolerance</td>
<td>10%</td>
<td>7%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Multiple Lamination Cycles</td>
<td>5</td>
<td>7</td>
<td>7+</td>
<td></td>
</tr>
<tr>
<td>Copper Foil Weights (Internal Layers)</td>
<td>1/2 - 3 OZ</td>
<td>1/4 - 4 OZ</td>
<td>1/4 - 6 OZ</td>
<td></td>
</tr>
<tr>
<td>Copper Foil Weights (External Layers)</td>
<td>1/2 - 3 OZ</td>
<td>1/4 - 4 OZ</td>
<td>1/4 - 6 OZ</td>
<td></td>
</tr>
</tbody>
</table>
## Pad, Lines & Spacing Diameters

<table>
<thead>
<tr>
<th>Feature</th>
<th>.004&quot;</th>
<th>.003&quot;</th>
<th>.002&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Line Width</td>
<td>.004&quot;</td>
<td>.003&quot;</td>
<td>.002&quot;</td>
</tr>
<tr>
<td>External Spacing</td>
<td>.004&quot;</td>
<td>.003&quot;</td>
<td>.002&quot;</td>
</tr>
<tr>
<td>Internal Line Width</td>
<td>.004&quot;</td>
<td>.003&quot;</td>
<td>.002&quot;</td>
</tr>
<tr>
<td>Internal Spacing</td>
<td>.004&quot;</td>
<td>.003&quot;</td>
<td>.002&quot;</td>
</tr>
<tr>
<td>External Pad Size - Annular Ring Per Side</td>
<td>.005&quot;</td>
<td>.004&quot;</td>
<td>.003&quot;</td>
</tr>
<tr>
<td>Internal Pad Size - Annular Ring Per Side</td>
<td>.005&quot;</td>
<td>.004&quot;</td>
<td>.003&quot;</td>
</tr>
<tr>
<td>SMT Pitch</td>
<td>.8mm</td>
<td>.65mm</td>
<td>.5mm</td>
</tr>
<tr>
<td>BGA Pitch</td>
<td>.8mm</td>
<td>.65mm</td>
<td>.5mm</td>
</tr>
</tbody>
</table>

## Impedance

- **10%**
- **5%**
- **2.5%**

## Plating Finishes

<table>
<thead>
<tr>
<th>Finish Type</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENIG (Electroless Nickel Immersion Gold)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENPIG (Electroless Nickel Palladium Immersion Gold)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immersion Silver</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Immersion White Tin</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HASL (60/40 Tin-Lead)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HAL (Lead-Free)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Nickel (Electroplated)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Palladium (Electroplated)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Gold (Electroplated)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Soft Wire Bondable Gold</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>OSP (Organic Surface Protection)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Carbon Ink</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Selective Plating</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</tbody>
</table>

## Tolerances

<table>
<thead>
<tr>
<th>Feature</th>
<th>10:1</th>
<th>15:1</th>
<th>20:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilled Hole To Copper</td>
<td>.008&quot;</td>
<td>.005&quot;</td>
<td>&lt; .005&quot;</td>
</tr>
<tr>
<td>Plated Hole Tolerances (+/-)</td>
<td>.003&quot;</td>
<td>.002&quot;</td>
<td>&lt; .002&quot;</td>
</tr>
<tr>
<td>Non Plated Hole Tolerances (+/-)</td>
<td>.001&quot;</td>
<td>.001&quot;</td>
<td>.001&quot;</td>
</tr>
<tr>
<td>Fabrication Tolerances (+/-)</td>
<td>.005&quot;</td>
<td>.003&quot;</td>
<td>&lt; .003&quot;</td>
</tr>
</tbody>
</table>

## Via Holes

<table>
<thead>
<tr>
<th>Feature</th>
<th>0.004&quot;</th>
<th>0.003&quot;</th>
<th>0.002&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Micro Vias</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blind Vias</td>
<td>0.0063&quot;</td>
<td>0.0063&quot;</td>
<td>0.0063&quot;</td>
</tr>
<tr>
<td>Buried Vias</td>
<td>.0063&quot;</td>
<td>.0063&quot;</td>
<td>.0063&quot;</td>
</tr>
<tr>
<td>Via Holes Under PAD</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Laser Drill</td>
<td>Outsourced</td>
<td>Outsourced</td>
<td>Outsourced</td>
</tr>
<tr>
<td>Mechanical Drill Vias</td>
<td>0.0063&quot;</td>
<td>0.0063&quot;</td>
<td>0.0063&quot;</td>
</tr>
<tr>
<td>Tented Vias</td>
<td>Coated with LPI</td>
<td>Coated/Plugged</td>
<td>Coated/Plugged</td>
</tr>
<tr>
<td>Silver Conductive Via Filled</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Copper Conductive Via Filled</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-Conductive Via Filled</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Copper Plated Plugged Vias (80%) .008&quot; Min</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Automated Planarization Capability</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Drilling outsourced
Solid Copper Fill
Backdrill
Materials

• GFN (FR4) 170 Tg to 185 Tg.
• GIN (Polyimide)
• Getek
• Teflon - Rogers / Taconic / Arlon
• Cynate Ester
• Teflon w/ thick copper, aluminum & brass.
• Flex materials (DuPont)
• Thermal Clads (Berquist) & Thermount (Arlon)
Surface Finishes

- Electroless Nickel Immersion Gold (ENIG)
- Electroless Nickel Immersion Palladium Immersion Gold (ENIPIG)
- Immersion Silver
- Immersion White Tin
- Soft Wire Bondable Gold
- Deep Well Nickel - Palladium-Gold (Hard / deep well)
- SMOBC/HASL
- HASL (60/40 Tin-Lead)
- HAL - Lead Free (99.3% Tin - .7% Copper – trace Ni)
- Selective Gold with alternative finishes.
- Organic Solderability Preservative (OSP)
Soldermask & Legend

• Liquid Photo Imagable Soldermask (LPI) high density, available in multiple colors: O O O O & Clear and some custom colors.
• LPI Silkscreening.
• Dry Film Soldermask
• Circuit Automation DP1500 TC120 Tunnel Oven
• Orbotech Sprint 120 Ink Jet Printing
Electrical Test

• 2-CircuitLine Precise 2S Dual-Sided Clamshell Testers.

• 2-Mania Technologies ULTIM8 Flying Probe Testers.

• Polar Instruments CITS 500s Controlled Impedance Test System.

• All PCB’s are Netlist electrical tested.
Cycle time options

• Prototypes : 24 hrs to 10 day turns
• Preproduction quantities: 24 hrs to 15 days
• Production quantities: 5 days to 4 weeks
• Boards are priced by the cycle time requested/quoted
• Scheduled deliveries on production available
• High volume quantities & deliveries (Domestic & Offshore).
• Offshore manufacturing for commercial products only.
Contact Information:

• Quotes should be sent to: sales@multilayer.com

• Specify: Quantity(s) & lead times to be quoted.

• Supply Drawings, Readme and Gerbers in a zip file.
Mission Statement:

Multilayer Technology is committed to providing products and services that meet or exceed our customers' requirements through a dedicated program of continuous measurable improvement that is supported by all our employees and suppliers. 

Customer Satisfaction Is Our Number One Priority.
Please visit our website for more information regarding our Certifications, a complete IPC1710A site survey, services and capabilities. Our newsroom will keep you up to date on events, trade shows, expansions, equipment upgrades and new technology trends.

WEBSITE: www.multilayer.com
Our Team of professionals is dedicated to delivery you the highest quality and service, this has been our philosophy for over two decades. Our clients have and will always be our first priority. Our company success has grown based on this commitment.
High Frequency/RF Materials
Applications & Trends
Definition

• Definition of “high frequency” materials
  – Utilization for high data transfer rates
  – Extremely low Loss (Df<.010)
  – Very High or Very Low Er(10.6-2.2)
Wireless Applications

| Frequency (GHz) | 0.1 | 0.15 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.75 | 1 | 1.5 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 15 | 20 | 30 | 40 | 50 | 60 | 70 | 100 |
|-----------------|-----|------|----|----|----|----|----|-----|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Typ. Max Freq.  | 10  | 6    | 4  | 3  | 2  |    |    |     |   |     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

- GSM
- GSM WAN
- PAGER
- VHF
- TV
- GPS
- FM
- UHF
- TV
- MMDS
- LAN
- RFID
- PCS, PHS, PAGER
- LMDS
- RADAR DETECTOR
- COLLISION AVOIDANCE
What functions do they serve?

- Reduce signal loss via reduced dielectric loss
- Reduce power consumption
- Reduce signal reflection
- Reduce crosstalk in Higher Density Packages
- Reduce EMI emissions
- Reduce dielectric thickness (more I/O in same envelope)
Supply Base

• Most CCL suppliers offer some version of High Frequency materials
• Base systems
  – Modified Epoxy
  – Modified PTFE
  – PTFE
  – LCP
  – Foam
High Frequency Material Focus

• Previous
  – Modified epoxy filled for lower Er
  – Thinner dielectrics
  – Change from E-glass (Er~6.0) to S-Glass(Er~3.5)

• Current/Future
  – Modified epoxy filled to lower Df
  – Customized Er with consistent Df
  – Woven PTFE
  – LCP
  – Foam Copper Clad
Limitations of FR4

• Unknown Dielectric Constant Tolerance
• Dielectric Constant Too High
• Change of Dielectric Constant vs. Temperature
• Moisture Absorption Effects
• High Dielectric Loss
• Process Limitations (Tg)
HYBRID CONSTRUCTIONS

• Mixing of more exotic materials
• Internal and external patches of multiple materials
HYBRID 4

.005 CLTE Teflon
.002 LCP
.010 6002 Teflon
.002 LCP
.010 3003 Teflon
.002 LCP
.005 CLTE Teflon
25 Ohm Ohmega
16 Element Phased Array Antenna
ANALOG/DIGITAL HYBRID TECHNOLOGY

• Complete consummation of mixed dielectrics
• Improves speed due to omission of insertion loss from interface cables.
• Improved speed/lower loss
• Complete plane or “patchwork” available
• Accurate modeling of mixed dielectrics
• Stripline Resonance coupon to run at system speeds
• Potential to reduce footprint allowing to add more features
• Tighter control of impedance for critical designs
HYBRID

Digital

Analog

PTFE
HF-FR-4 ATE DUT Product

High Frequency 20GHz DUT
Low Df Low Er Materials
40 Ghz RF Module
PTFE/Flex/Optical
PTFE Amplifier
PTFE/Conductive Filled Holes
Medical Gamma Ray Scanner

12 layer Sequential Lamination
Buried/Blind Via's
Wirebondable Soft Au
Jet Propulsion Labs
Satellite Board

Sequential Lamination Hybrid
4 Layers 6002 Conductivity Filled Via's
2 Layers 50 Ohm Ohmega Resistors
Northrop Grumman Avionics Board
Processing High Frequency Materials

- Dimensional Stability/Instability
  - Epoxy based/PTFE based
- Mixed materials characterization
  - Electrical
  - Mechanical
- X/Y/Z CTE
- Viscosity Curves
- Drill
- Desmear
- PTH
Summary

• IC speeds will continue to increase
• Design and materials will pose a “roadblock” to system performance
• High Speed Digital circuits will function more like Analog/RF circuits with EMI and Return Loss being critical factors.
• Both Long run (multi switch cards) Short run (packaging substrates) will face limitations
• Burden will fall on Fabricators/Designers and Material suppliers (in that order)