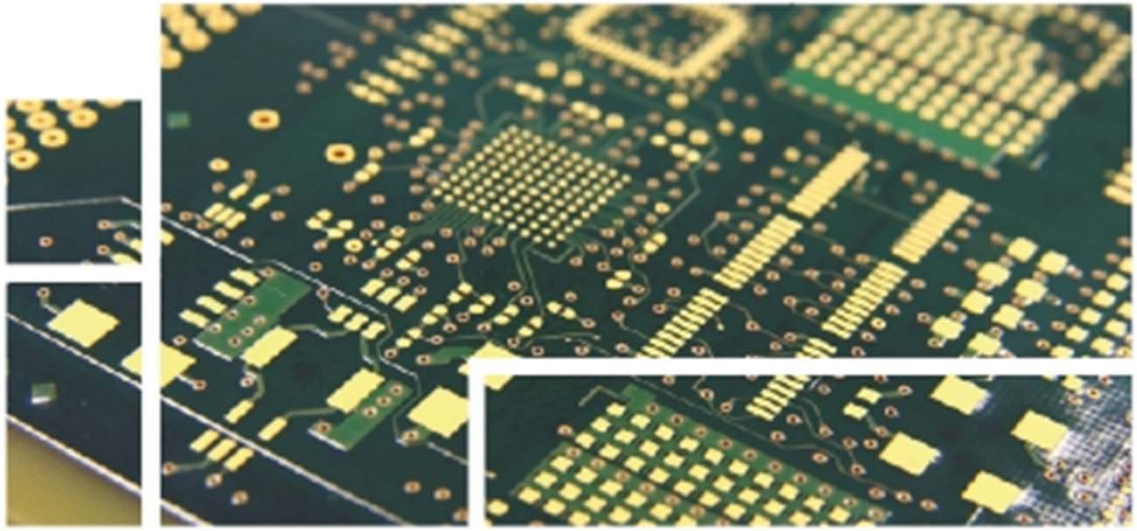
FINMASI GROUP

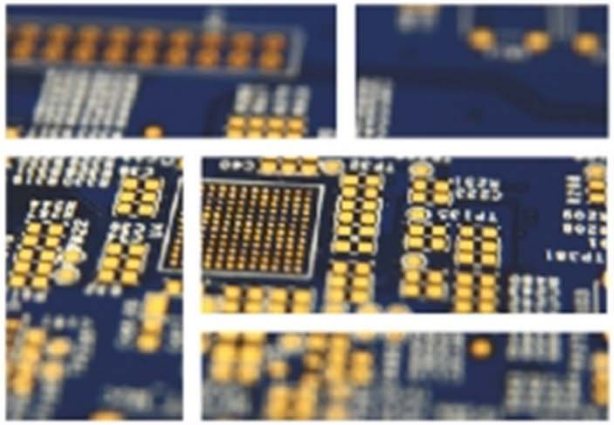
"Looking for the best wind"



esa 5th electronic materials, processes and packaging for space workshop (EMPPS)
20 - 22 may 2014, esa-estec, the netherlands European Space Agency

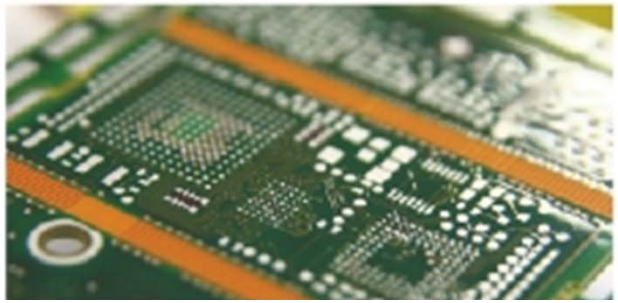
A conscious and "Risk Less" approach to complex pcb for avionic and space application

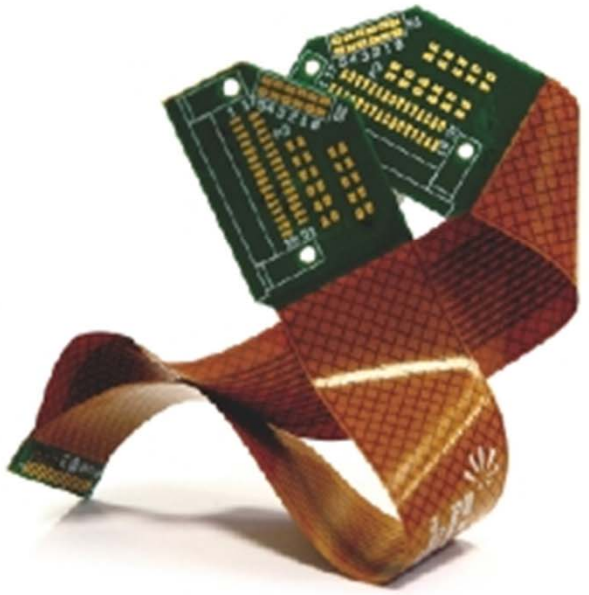
Autor: Luca Pagnani



CISTELAIER

Unique, like the PCB you need





Who we are....

Cistelaier spa is part of an industrial group named FINMASI, focused on different business activities from steel service to sensor production.

We are part of the pcb division of FINMASI Group together with TechCi Rhone-Alpes and Cistec: our pcb division reach around 30mil Euro of Turnover in the last year.

Strengths of Cistelaier:

- Technological know-how in different technologies: Multilayer (up to 40 layer), HDI (4+N+4), Rigidflex (Up to 32 layer with 6 layer flex) and Mixed Material Layup (rigid and rigid flex with ceramic or teflon base material)
- Special product: Back drilling, Heavy copper up to 500um um (internal/external), CIC and Max dimension up to 860x410 mm
- Flexibility: from prototype to volume
- Very quick turn around service: 2wd for Multilayer / 3-6 wd for HDI / 4-6wd for Rigidflex

Consistent presence in different market sectors in Europe:

- Military - Avionic
- Industrial
- Space
- Automotive
- Railways
- Medical
- Telecommunications

Cistelaier References

FINMASI GROUP

SIRIO PANEL

SELEX ELSAG

OTO MELARA
A Finmeccanica Company

SELEX
Sistemi Integrati

FINMECCANICA

SELEX GALILEO

THALES

WASS
A Finmeccanica Company

COBHAM

SAAB

NORTHROP GRUMMAN

ThalesAlenia
A Thales / Finmeccanica Company
Space

AnsaldoSTS

Vestas

CONTRINEX

SICK
Sensor Intelligence.

MTA
Advanced Automotive Solutions

Esterline

Endress+Hauser

METTLER TOLEDO

SELTA

Continental

Stago

elca

cefla

MAGNETI MARELLI

ASTEELFLASH GROUP

ERICSSON
TAKING YOU FORWARD

TELESTE

Nokia Siemens Networks

Alcatel·Lucent

JABIL

FLEXTRONICS

CISTELAIER

TechCi References

How to approach complex board

STABLE QUALITY SYSTEM WITH MULTIPLE ADKNOLEDGE

KNOW-HOW IN COMPLEX BOARDS/ADVANCED TECHNICAL CAPABILITIES QUICK TURN AROUND AND SERIAL PRODUCTION VOLUMES TO BE ABLE TO SUPPORT WITH STABLE PRODUCT THE CUSTOMER

CO-DESIGN AND DESIGN FOR MANUFACTURING (DFM) WITH DIRECT CONTACT WITH CUSTOMER, RISK ANALYSIES WITH SPECIFIC TOOLS DISCUSSED WITH CUSTOMER TO "MITIGATE THE RISK"

SKILLED AND RELIABLE HUMAN RESOURCES

STATE OF THE ART EQUIPMENTS AND MACHINES – INVESTMENT

SOME TECHNOLOGY EXAMPLE OF APPLICATION

Quality, Certification & Compliance

Quality Management:

- ISO 9001:2008
- UNI EN ISO 13485:2003 (Medical devices)
- ISO/TS16949:2009 (Automotive)
- IRIS–International Railway Industry Standard
- UNI EN 9100:2009 (Aeronautic, Space and Defense)
- UNI ISO 14001:2004 **planned for last quarter 2014**
- OHSAS18001 **planned for 3rd quarter 2015**

UL certifications:

- UL94 V-0 certification and **UL796 DSR extension**
- UL approval for rigid-flex

IPC compliances:

- IPC–A-600H standards, Class 2 , Class 3 or according to Customer's specifications.
- IPC 6012(Rigid), IPC 6013(Flex-RigidFlex), IPC6016(HDI) and IPC6018(Microwave).

MIL compliances:

- MIL-P-55110 (military std for rigid boards)
- MIL-P- 50884 (military std for rigid-flex boards)

Member of CISQ Federation
RINA
ISO 9001:2008
Certified Quality System

Underwriters Laboratories

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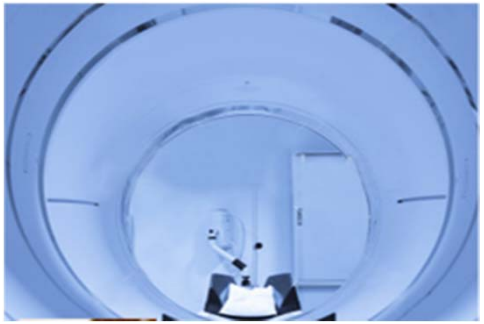
Main Objectives for these standards



Medical Device

This is a voluntary standard designed to govern the production of medical device based on **"Risk Analysis"**.

The achievement of ISO 13485 certification assures the constant monitoring of processes, from raw material purchase to product delivery, with the aim of identifying possible risks and, consequently, the activities aimed at prevent or solve them with **"Risk Analysis"** and **"Mitigation process"**.

Thanks to this peculiarity the system is in constant evolution because for each new part number all process are reviewed to check if aligned with the requirement.

Aero-Space and Defense

The EN 9100 is recognized by the companies in aero, space and defense sector.

It allows the company to prevent the product-risk defining an appropriate control system, like **"Design For Manufacturing", "Key Point Analysis"** an **"FMEA- Failure Mode and Effect Analysis"**. The system manages internal processes, in particular the **"Special Production Process"** and **"FOD-Foreign Object Debris Management"**.

This Quality Management System improves company organization and reduce costs throughout the value chain.

Automotive

The ISO/TS-16949 is a technical specification that defines the quality system requirements for the production of automotive-related products, based on strong **"DFM – Design For Manufacturing"** analysis and **"PFMEA – Process FMEA"** with a final target to assure a constant quality and quality improvement in the direction of a "zero" defect strategy.

It aligns all current standards used in the automotive industry (the Americans' QS-9000, the Germans' VDA6.1, the French's EAQF, and the Italians' AVSQ) into one global specification.

Railway

IRIS (International Railway Industry Standard) complements the internationally recognized ISO 9001 quality standard introducing rail specific requirements: based on **"Key Point Analysis"** and **"Risk Analysis"**.

IRIS was created on the basis of similar quality standards in the aerospace and automotive industries and it helps avoiding multiple business management system and therefore optimizes costs.

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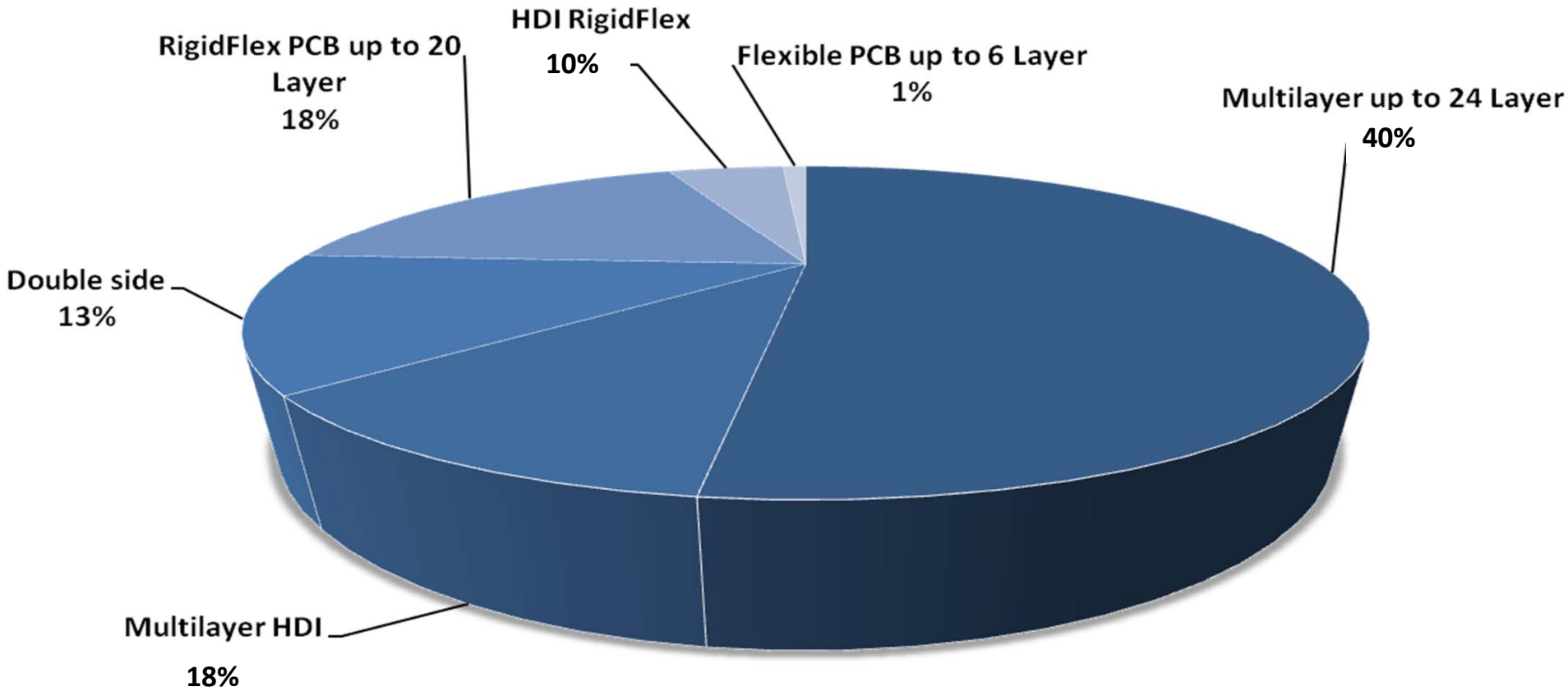
KNOW-HOW IN COMPLEX BOARDS AND ADVANCED TECHNICAL CAPABILITIES

General picture of knowhow...

…in base on a complete product portfolio with different technologies from the simple Double Side to the more complex Multilayer, also Rigid-Flex, up to 40 layers.



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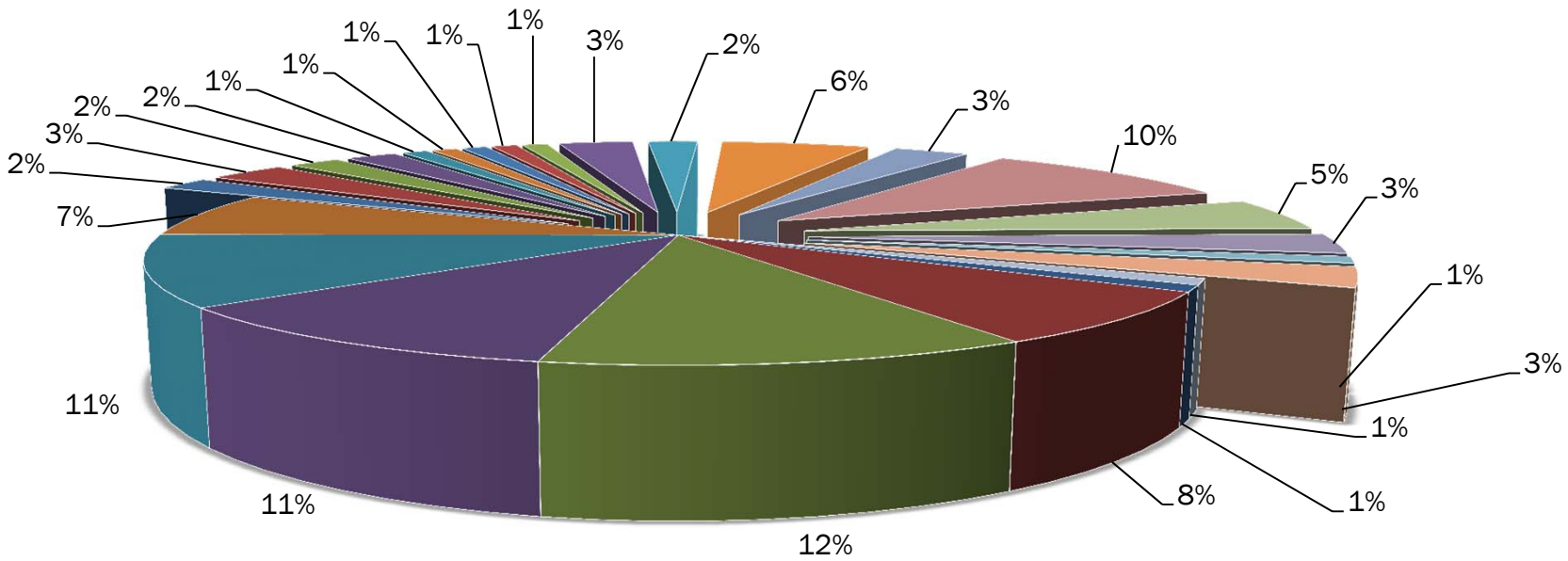
HDI variations...

...in base on different known costruction on rigid board and ....



- Multilayer BlindVias - 3 Layer 1%
- Multilayer BlindVias - 4 Layer 8%
- Multilayer BlindVias - 6 Layer 12%
- Multilayer BlindVias - 8 Layer 11%
- Multilayer BlindVias - 10 Layer 11%
- Multilayer BlindVias - 12 Layer 7%
- Multilayer BlindVias - 14 Layer 2%
- Multilayer BlindVias - 16 Layer 3%
- Multilayer BlindVias - 18 Layer 2%
- Multilayer BlindVias - 20 Layer 2%
- Multilayer BlindVias - 22 Layer 1%
- Multilayer BurriedVias - 6 Layer 1%
- Multilayer BurriedVias - 8 Layer 1%
- Multilayer BurriedVias - 10 Layer 1%
- Multilayer BurriedVias - 14 Layer 1%
- Multilayer BurriedVias - 22 Layer 3%
- Multilayer BlindVias + BurriedVias - 4 Layer 2%
- Multilayer BlindVias + BurriedVias - 6 Layer 6%
- Multilayer BlindVias + BurriedVias - 8 Layer 3%
- Multilayer BlindVias + BurriedVias - 10 Layer 10%
- Multilayer BlindVias + BurriedVias - 12 Layer 5%
- Multilayer BlindVias + BurriedVias - 14 Layer 3%
- Multilayer BlindVias + BurriedVias - 16 Layer 1%
- Multilayer BlindVias + BurriedVias - 18 Layer 3%
- Multilayer BlindVias + BurriedVias - 20 Layer 1%

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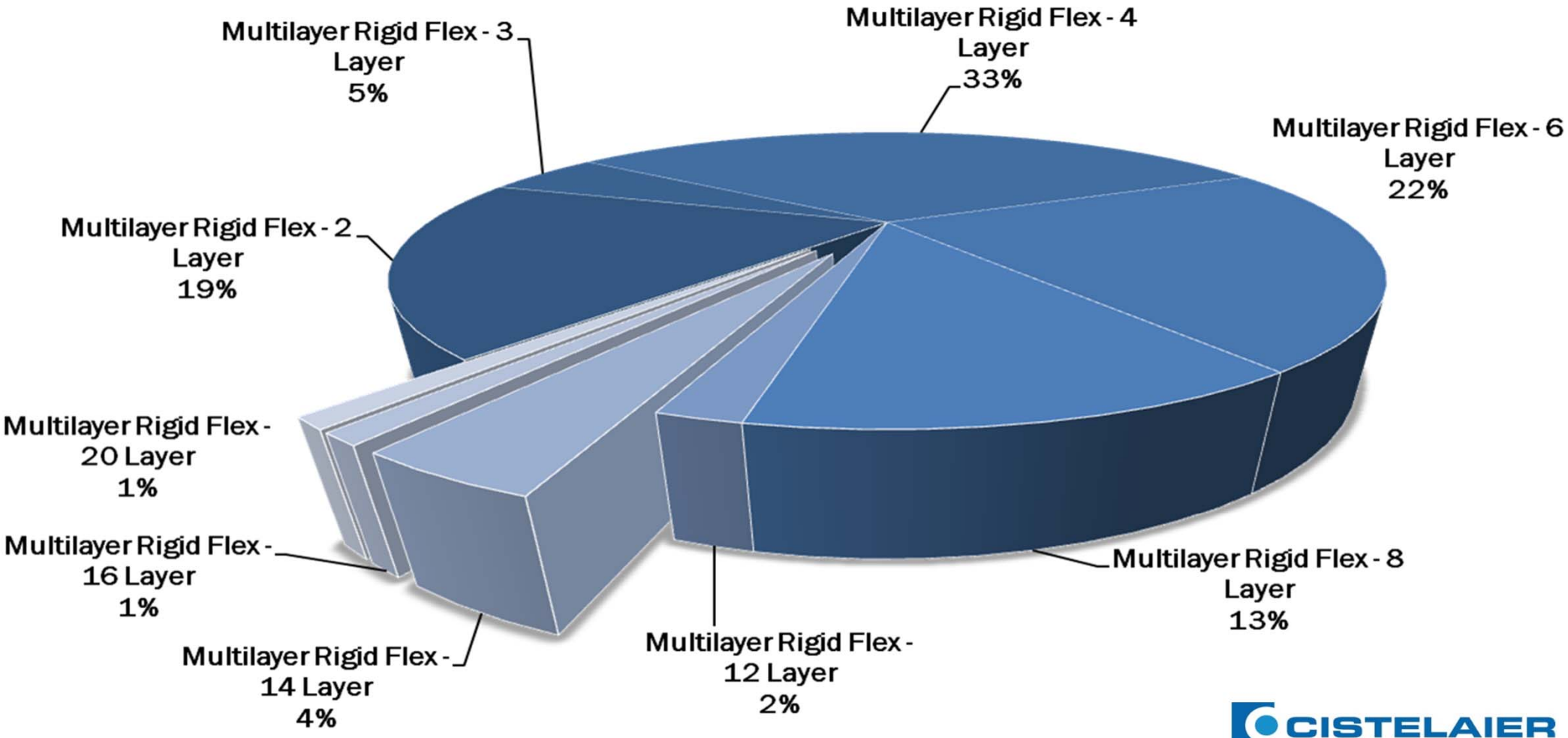
RigidFlex ...

Cistelaier SpA is able to produce different kind of layup helping all design and technical requirements on the Rigid Flex market.



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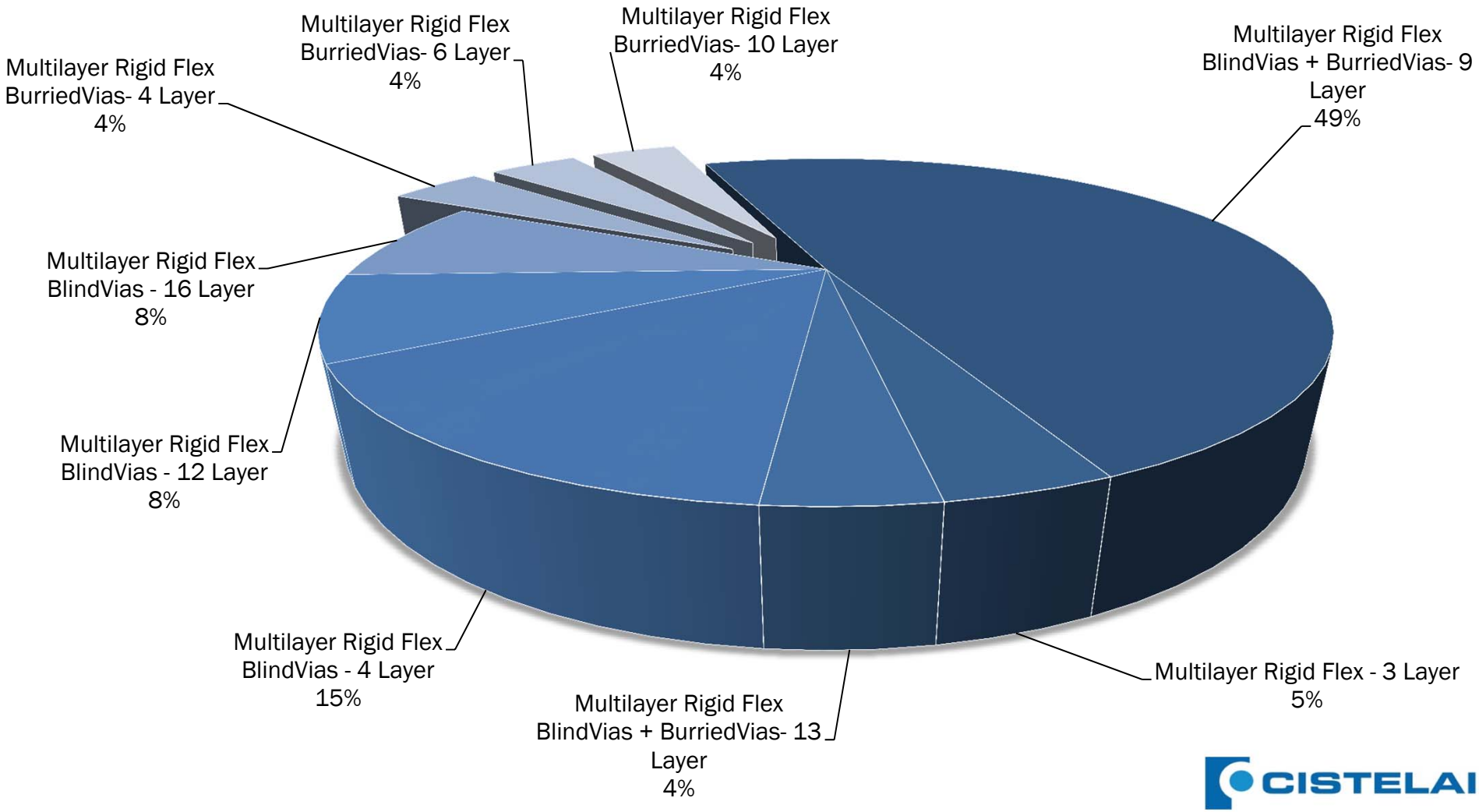
HDI Rigid flex variations...

...in base on different known constructions of rigid flex pcb.



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Pre production product analysies

From Cistelaier point of view
with a Customer Oriented Mentality
and Co-Design Approach.

Three person dedicated to DFM and technical customer support also with native language to reduce the “language” barrier

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Feasibility & Risk Analysis

Co-Design and DFM analysis in the early stages of PCB design in order to check the manufacturability aspects of the design: DFM validation is part of every PCB layout process and ensures that the designs will smoothly pass PCB manufacturing and assembly.

The design validation includes all checks to verify all requirements and constraints which influence manufacturability.

Based on Ucamco – Integr8tor : this software gives the possibility to make a first rapid analysis on the gerber file: the result is a pdf report with design characteristic, pcb external layer simulation and all gerber files in pdf format (high resolution).

File generated:

- Pdf report
- Top layer simulation in pdf
- Bottom layer simulation in pdf
- Gerber file in pdf

The report file can be used also by customer like technology sheet during RFQ to speed up our quotation.

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Evaluation chart

Item	Description (all relative measure are expressed in µm)	Classification								
		Standard				Advanced			Engineering R&D	
		5	6	7	8	9	10	10		
Track & Gap	min Track to Track (TT)/Track to Pad (TP)/Pad to Pad (PP)/Thermal Line Width (TW)	150	125	100	87	87	75	75	60	50
	min Track Width (MTW) / min Thermal Gap (GAP)				87	75	87	75	60	50
Ring Rigid pcb	min Outer Layer Annular Ring (OAR) on Production Hole Diameter (PHD)	150	125	100	100	100	100	100	87	75
	min Inner Layer Annular Ring (IAR) / Thermal Annular Ring on PHD	175	150	150	125	125	100	87	75	
Hole Diameter	min Production Hole Diameter (PHD) for thickness (Others: see table)	400	350	300	250	250	200	150	125	100
	max aspect ratio PTH: see also table (Thickness / PHD)	4	5	6	8	10	11	12	14	16
µvia – Burried via	min blind µvia drill diameter - material with glass				150	125	100	75	50	50
	max blind µvia aspect ratio - material with glass (Thickness / PHD)				0.5	0.6	0.7	0.8	1.0	1.0
	min blind µvia drill diameter - material without glass				125	100	87	75	67	50
	max blind µvia aspect ratio - material without glass (Thickness / PHD)				0.55	0.65	0.75	0.85	1.0	1.0
	µvia top pad annular ring				100	75	60	50	50	50
	µvia landing pad annular ring				100	75	60	50	50	50
	µvia holewall distance to cu				200	175	150	150	140	130
	max number of laser runs/side			1	1	1	2	3	4	4
	max number of burried vias			1	1	2	4	6	8	10
Drill /Cu Distance	PTH to cu on inner layers (means IAR + Value)	+75	+75	+75	+75	+75	+75	+68	+60	+50
	NPTH to cu on inner layers /NPTH Routing always>250 µm (means IAR+Value)	+50	+50	+50	+50	+50	+50	+50	+50	+50
	NPTH to cu on outer layers (NPTH Routing always >200 µm)	250	200	200	200	200	150	125	100	75
Cu Thickness	maximum total cu thickness that can be etched (no minimum)	70	50	40	25	20	20	15	15	12
Solder Mask	solder mask annular ring (MAR) & conductor overlap (MOC): typical	80	75	75	75	60	60	50	40	30
	solder mask annular ring (MAR) & conductor overlap (MOC): exceptional			60	60	50	40	30	25	25
	solder mask min segment (MSM) (If Cistelaier creates SM, MSM >= 100)	125	110	100	100	90	90	80	70	60
Build up	max pcb thickness (mm)						>3.2	>3.2	5.00	5.20
	min pcb thickness tollerance (%)	10	10	10	10	10	8	7,5	5	5
	max nr. Layers (for the Flex layer add 1unit in complexity)	12	16	18	20	22	24	26	32	40

Ring ML Flex & Flex-Rigid Flex layers (for rest = 0) should be 50 µm bigger then on rigid layers;

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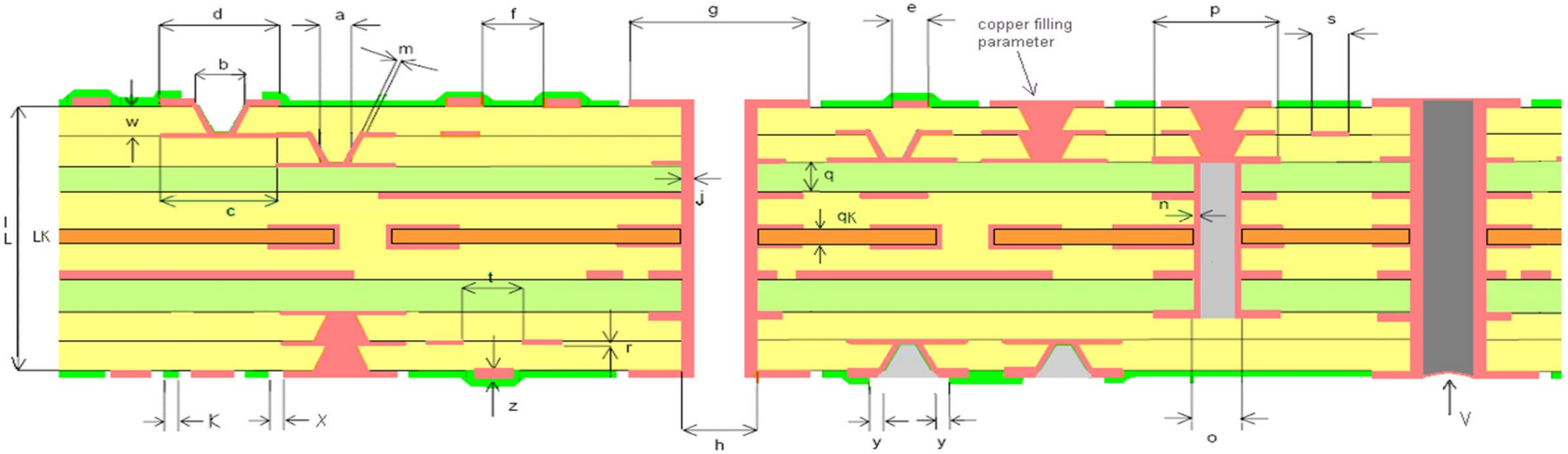
Technology Parameters



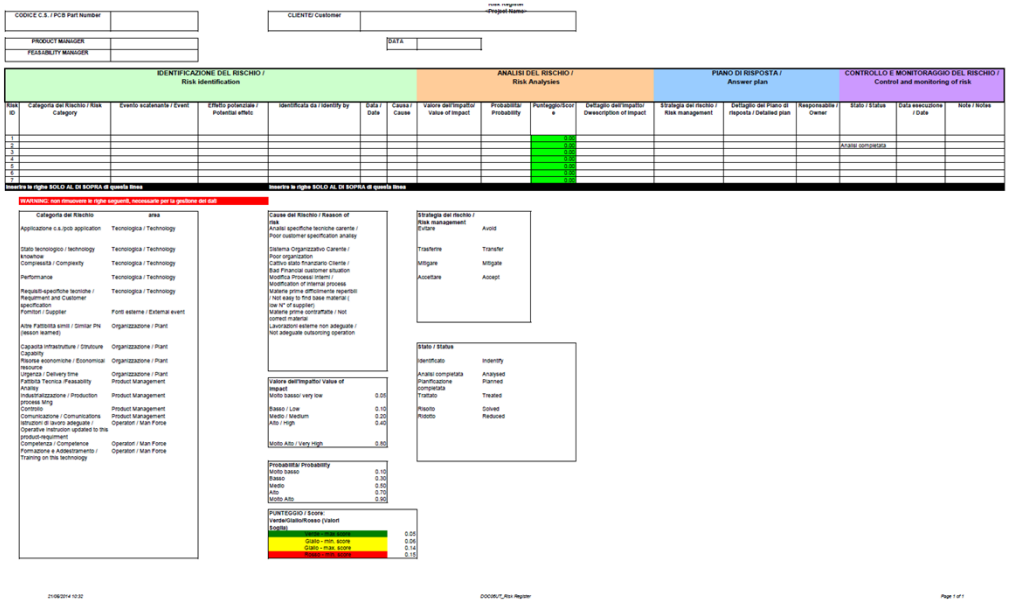
Symbol	Parameter	Value
A/B	Min Vias laser	50 µm
C/D	Min. Anular ring on laser via	>+100 µm
E/F	Min. line/space on base Cu9um–Outer layer	68 µm
G/P	Min. Anular Ring on Burried hole and PTH	>+150 µm
H/O min	Min. Mech. Plated Through Hole → I value	0.1 mm
H max	Max. Plated Through Hole	Unlimited
O max	Max. Plated Burried hole	1.2 mm
I min	Min. core thickness on DS - flex	25 µm
I max	Max. pcb thickness on ML	
L	Max. No. of Layers	40layers
Lk	Max. No. of Flex Layers	12layers
M	Min. Cu th.ss in laser/blind vias	>12 µm

Symbol	Parameter	Value
J/N	Min. Cu Th.ss in Burried and Through vias	>20 µm
Q	Min. thickness rigid base material	50 µm
Qk	Min. thickness flexible base material	25 µm
S/T	Min. line/space on base Cu17um–Inner layer	68 µm
R	Min. Copr Th.ss Inner layer	12 µm
Z	Min. Copr Th.ss Outer layer	9 µm
V	Dimple in resin filled plated Through hole	<18 µm
W	Min. prepreg core thickness	50 µm
Y	Min. Solder mask Oning on vias	100 µm
K	Minimum Solder mask dam	75 µm
X	Min. solder mask clearance	50 µm
Cu Filling	Design parameter for best copr filling	W=75 µm /B=90 µm

Risk Analysis: specific register

We use a specific "Risk Register" (PDF) – (Excel) where at different level all aspect of the risk management of the pcb production are treated with the intent to know the risk , analyze it and minimize it.

With this register, we touch different point that can have impact on the pcb production and final result starting from:



- Pcb application
- Technology knowhow
- Complexity Performance
- Requirment and Customer specification
- Supplier of base material
- Similar PN (lesson learned)
- Strutcure Capablity
- Delivery time required
- Feasability Analisy and Production process Mng
- Operative instrucion updated to this product-requirment
- Competence
- Training on this technology (Need of)

R&D Vision and Co-design

Cistelaier Co-Design and DFM Validation …

Co-Design and DFM analysis in the early stages of PCB design in order to check the manufacturability aspects of the design.

DFM validation is part of every PCB layout process and ensures that the designs will smoothly pass PCB manufacturing and assembly.

The design validation includes checks on track widths/global spacing, unterminated traces, copper features, route cleanup, fiducials, drill features, soldermask/solderpaste openings, impedance/stack requirements and many other constraints which influence manufacturability.

… and R&D Vision: providing best-in-class Technology for future interconnection needs!

Cistelaier Research & Development is the driving force for identification of new technology options for creating interconnection solutions.
We do this by continuously scanning and developing potential novel technologies, and monitoring closely the application scenarios offered by the advancement in avionic/military, telecom, automotive and other business sectors.
Our goal is to provide insight into new technologies, reduce the cycle time to introduction of new technologies into the production and thereby enable the continued support of our customers.

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"Coiche of the right material choice ...first of all! (Part1/2)

Laminates are increasingly important to high-performance PWBs and have to be reviewed under thermal-mechanical and electrical aspects.

CTE
Thermal expansion in x-, y-and z-axis with special impact on the z-axis for the reliability of the vias (e.g. barrel cracking) and withstand multiple pressing processes

Loss tangent (Df) and permittivity (Dk)
Parameters for signal integrity and impedance requirements

Glass type and resin content
New laminate features are uniform glass to laser drill easier, thinner glass for better electrical properties, thin and high dielectrics for distributed capacitance between power and ground, and a wide range of laminates with embedded passive layers to form resistors and/or capacitors.

Glass transition temperature Tg
The temperature at which the material stops acting as a rigid material

Decomposition temperature Td
Higher heat resistance is needed for lead-free assembly processes: the new feature that laminates need is a higher Decomposition Temperature (called Td). This is the temperature that a laminate can withstand when it has lost 5% of its weight by thermal gravimetric analysis (TGA).

Humidity Impact
Important aspects may be the CAF Resistance and moisture absorption.

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Base Materials for PCB (Part2/2)

Wide range up to approx 1 meter long (rigid and rigid-flex)

Standard FR4, high Tg Laminates also Low Halogen and specific for High Speed Digital:

- Mid Tg epoxy for Lead-free process: ITEQ IT158 -Tg 160 °C
- Mid Tg epoxy for Lead-free process – Low Halogen: ITEQ IT40G -Tg 140 °C (also Noflow Prepreg)
- High Tg 180°C epoxy (without filler): ITEQ IT180 (also No/Low flow Prepreg); ISOLA IS420; ARLON 45N
- High Tg 180°C epoxy (with filler): Iteq IT180A; Isola PCL370HR
- High Tg 170°C epoxy – Low Halogen: Iteq IT170G – it170GRA (Low DK&DF);
- High speed digital applications 10 GHz: NELCO N4000-13 and SI; Isola Fr408HR; ITEQ IT200DK and IT150DA(SE)
- Gould TCR and Shipley INSITE – Embedded resistor

High-performances materials for avionic/military application:

- Polyimide Resin System: Arlon 33N, 35N, 85N; Ventec VT901(also No/Low flow Prepreg); Hitachi MCL-I-671; Arlon EP;
- Epoxy Resin System: Arlon® Kevlar 47NK (Tg 170 °C and 4.7 ppm/°C)
- ***Epoxy and Polyimide Thermount®: ARLON® 55NT/85NT***
- Copper/Invar/Copper : tipically 150 µm thick - 17/120/17 µm)
- Thick copper: up to 500 microns, for BusBar application also

Substrates for flexible circuits:

- Flexible Laminates-Kapton® based: DuPont PYRALUX LF; PYRALUX FR; PYRALUX AP (Adhesiveless);
- Flexible Laminates-Polimide based: UBE Upilex (Adhesiveless); Iteq (Adhesiveless);

High Frequency materials Teflon® based and non-Teflon based:

- Rogers®: Duroid Copper/Brass supported; RO3003;Rt5880; RT6002; TMM10
- Arlon®: AR350; AR600; AR1000; DiClad Family
- Rogers®: RO4350; RO4003;
- Arlon®: 25N; 25FR
- Taconic®: RF25A2; TACLAM Plus and all teflon family

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Most common risk registered on Space and Avionic product

Material choice:

- Thermount material: for how many time we will have material from actual supplier?
- Polyimide material supplied only from few supplier (USA , Japan and Taiwan/China)
- Low interest to test new material of new generation (for example modify filler epoxy with High Tg able to pass >3000cycle between -55/+155°C) commonly used in other sector

Copper Finishing:

- Tin Lead Refuse (Space):
  - Chemistry limit: not developed from long time and not aligned with the new design requirement: lower throughput power in microvias and blind vias, low speed in covering hole wall with high aspect ratio pcb
  - Healthy on galvanic bath: very old chemistry not aligned with future European normative
  - Healthy on metal alloy: the presence of Lead will be a problem
  - Healthy on oil reflow: big problem in the management of fumes and hot oil and cancer risk related to this fume
  - Safety on the pcb: extra thermal stress applied on pcb (must be added to assembly process cycle) and also on the edge of pad and track
- Hot air solder leveling(Military & Avionic):
  - Safety on the pcb (mainly on rigidflex): extra thermal stress applied on pcb (must be added to assembly process cycle)
  - Healthy on metal alloy: the presence of Lead will be a problem

Solder mask:

- Solder mask application(Space): some actual and future needs of design a pad definition with solder mask will be a need and a process

Design modification:

- Old product(Military and Avionic): not very open to modify old product to increase reliability and reduce failure (also of the final product) → too much limitation from configuration structure

Production plant:

- Training: update operators on the final application of product and quality demand (both from specific use and customer specification)
- Specification: customer not often use IPC reference in their specification and specific Control plan need to be created.

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“State of Art” and Key Equipment

Consciousness that only with “State of Art” Equipment and investment it is possible to support Avionic and Space market with good quality

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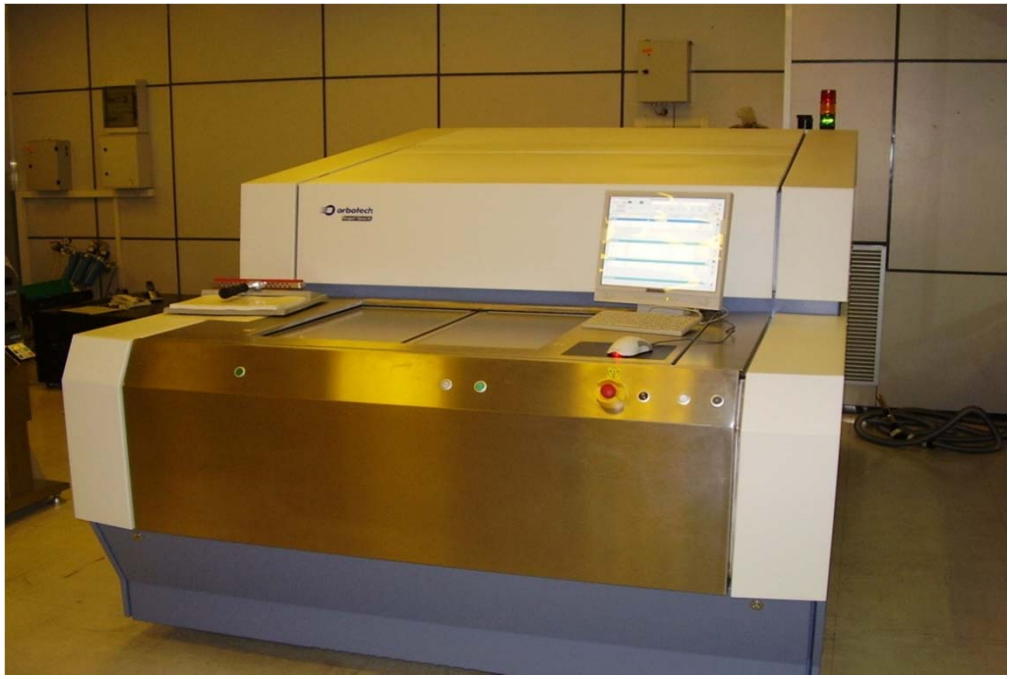
Laser Direct Imaging

There are two systems running: **Paragon 8000i** and **Paragon Xpress9**, by Orbotech (Israel), both of them are based on the latest solid-state laser technology.

- *"Paragon" system: modify to work on panel up to 914x610mm;*
- Wide working window: it can work on inner layers, outer layers, flexible material, SBU boards
- High resolution: minimum track/spacing is 25 µm (on Xpress);
- Side-to-side: registration accuracy(±10 µm)

Eliminates the need of phototool, with a very short set-up time.
Class 10.000 room, with class 1.000 in the LDI



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Lauffer Automatic press System with Automatic Loader/Unloader for Flex and Rigidflex

In the 2011 implemented and added a completely new department for the lamination of rigid-flex PCBs, a Lauffer system with automatic loading/unloading with 8 daylights cold + hot and it is already prepared for the implementation of a second press with 8 plates to duplicate capacity.
In the same department Cistelaier SpA has also installed a new high-temperature vacuum laminator, used for the application, as well as cover, photographic cover and dry film, including epoxy resins for SBU.

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Lauffer Automatic press System with Automatic Loader/Unloader for Rigid Multilayer & HDI

Two of them have 4 plates each, are heated by diathermal oil and can reach up to 250 °C, then the system has also the cold press zone for a better productivity: this help also to better control the cooling thermal cycle, very important to improve stability.

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Lauffer Automatic Press System
High temperature base materials 350°c

This system has 2 plates, also completely computer controlled, heated by diathermal oil and can reach up to 350 °C for special hot melt point material. The biggest dimension managed by this system is 1000x610mm panel format.

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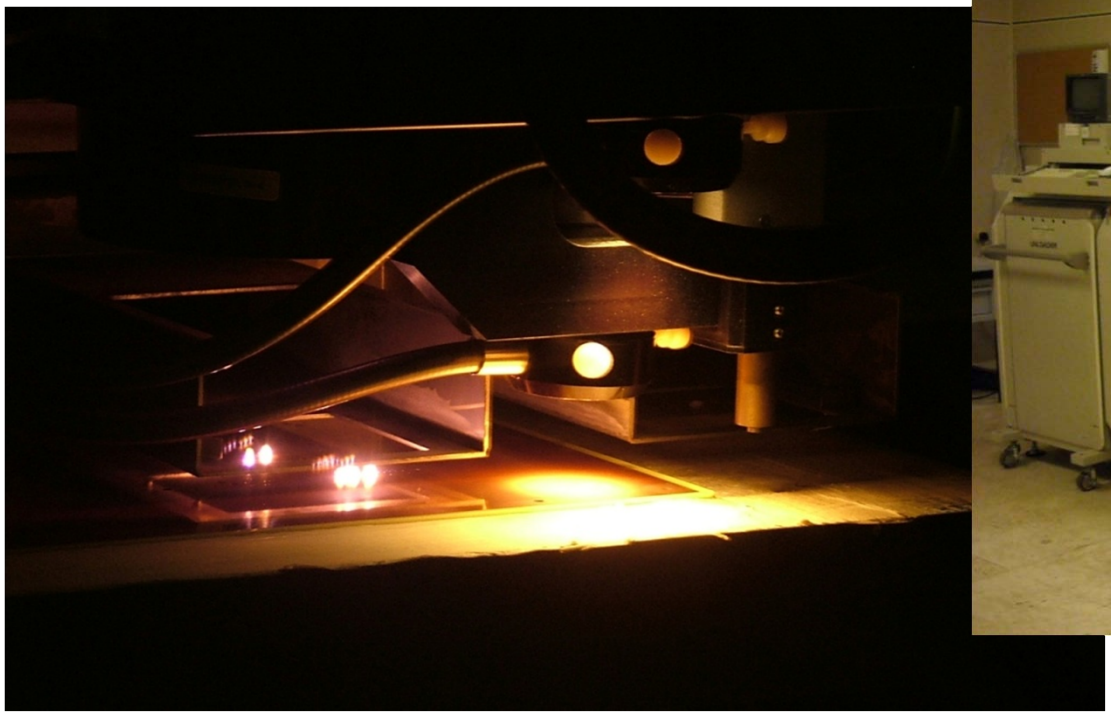
Laser Drilling

For microvias drilling we have an Hitachi Mechanical with these characteristics:

- Two laser heads: YAG solid state and CO2 gas-phase working in parallel
- Throughput: (1x1080, 17 µm Cu, hole diam. 100 µm): 45-50 holes/sec
- Typical Diameters: 100-127 µm
- Minimum Diameter: 50um on Hitachi
- Aspect Ratio: ≤ 1



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Plasma Desmearing

We use Europlasma CDX, by Europlasma (Belgium) and PlasmaTech, by Tepla (Germany).

Cistelaier SpA has four different plasma cycles to meet the needs of its Customers:

- Cycle for Teflon and Poliimmide base materials;
- Cycle for Kapton with acrylic adhesive (i.e.Pyralux LF);
- Cycle for Rogers 4350 (ceramic) and Polyester material;
- Cycle for soldermask cleaning for a better conformal coating adhesion.

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Plugging machine for supporting Capped vias requirement (Type VII in IPC 4761) (installed

New ITC Plugging Machine able to manage different filling paste (our standard is Taiyo THP100 DX1-HTG)

CISTELAIER

Automatic Galvanic Line

Cistelaier has invested in high performance and throughput automatic galvanic line made by PAL with automatic loader/unloader: this line is equipped with the latest electrolitic copper deposition chemicals process with reverse pulse rectifier and flooting shield.

A second galvanic is dedicated to the special chemistry for copper via filling, with special tanks designed for this purpose; best performance are achived with dielectric thickness of 75um with laser via diameter of 90um.

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AOI control (installed 6/2013)

New ORBOTECH Automated Optical Inspection System FUSION 22

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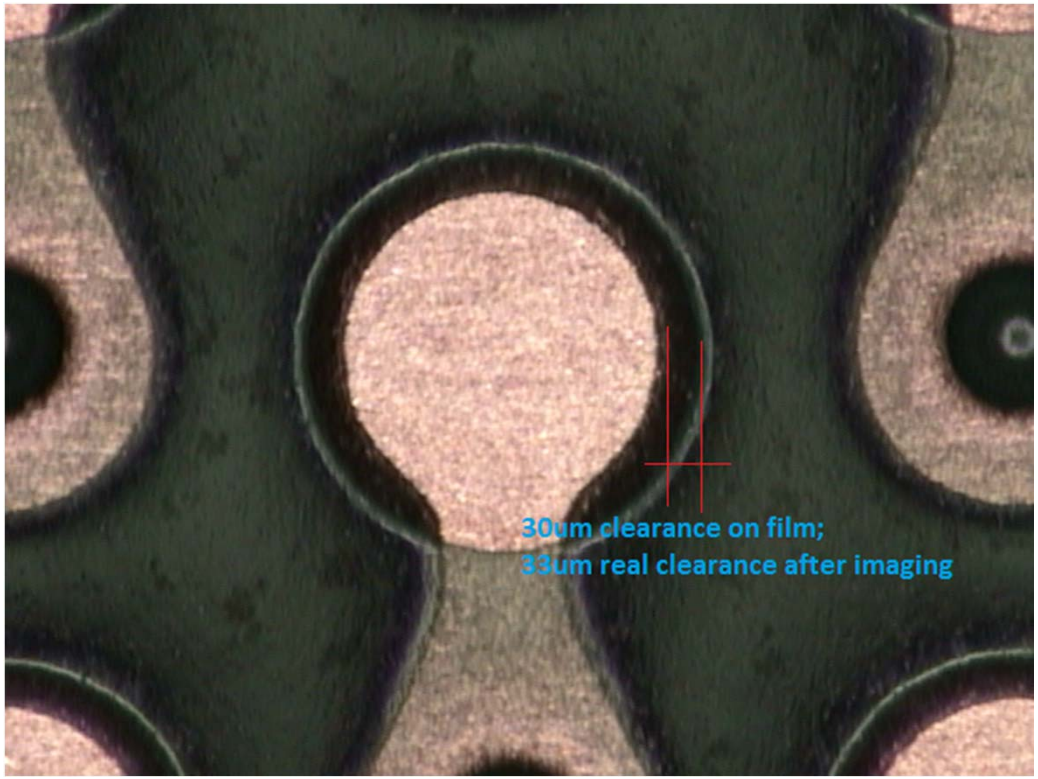
Legend Ink Jet print (installed 7/2013)

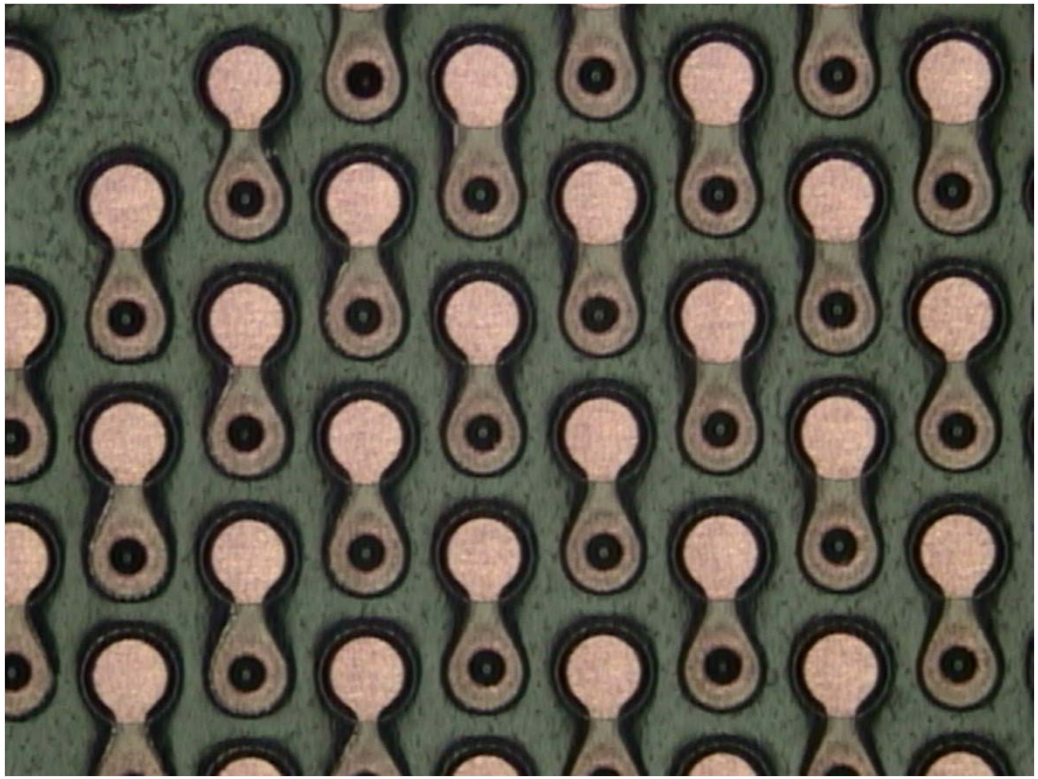
New ORBOTECH Legend Printing Machine – SPRINT 100
Able to manage also serialization and bar code printing also with barcode and 2D barcode

CISTELAIER

Exposure Systems

CBT Optical Alignment Exposure Unit able to align automatically the phototool on fiducial with an extreme high precision.





CISTELAIER

Multiple Surface Finish

All the main surface finishings requested by the market can be provided, in particular the "lead-free" ones:

- Tin-Lead Reflow – Shelf life 12 months
- HASL – Shelf life 12 months
- Lead-free HASL – Shelf life 12 months
- **Electroless Nickel-Gold (ENiG)**–Shelf life 6 months
- **Electroless Nickel-Palladium-Gold(ENePiG)**–Shelf life 6 months
- **Immersion Tin** – Shelf life 6 months

In out source:

- **Immersion Silver** – Shelf life 6 months
- Electrolytic Hard Gold – Shelf life 12 months
- Pure Gold for wire bonding – Shelf life 12 months
- **OSP**

- All finishing can be measured with a Fisherscope System, a non destructive system base on x-ray.

Notes:

- In bold the suggested for HDI product
- Selective and mixed finishes are possible

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Experience made

"High Density Interconnect"
Printed Circuit Board produced with the approached described before with different application

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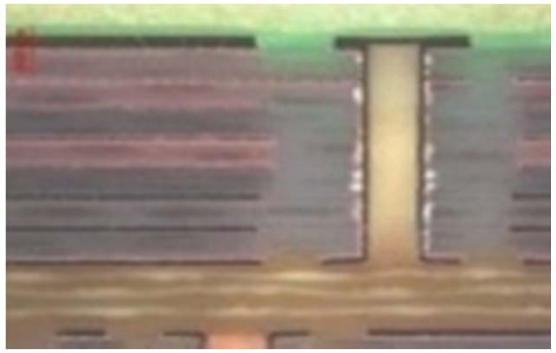
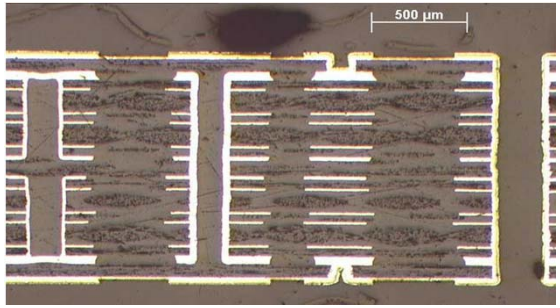
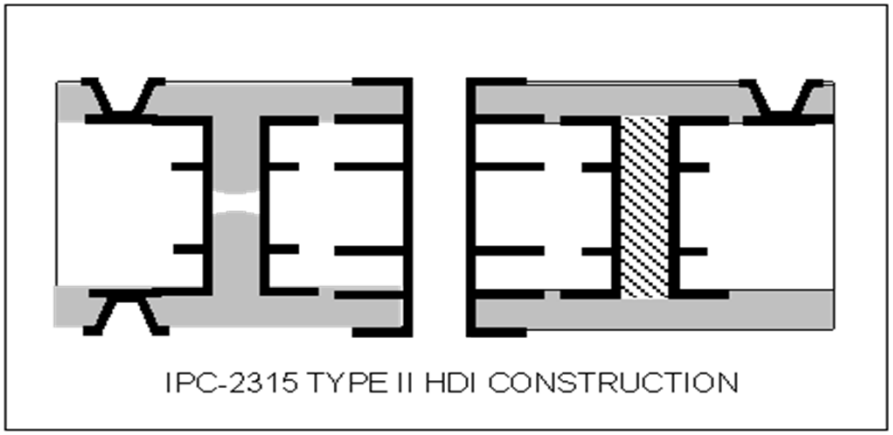
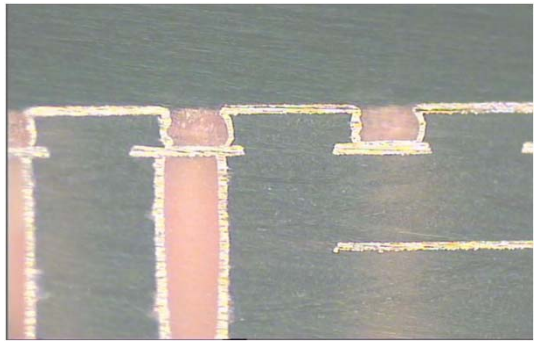
Sequential Build up 1+N+1 or N+N

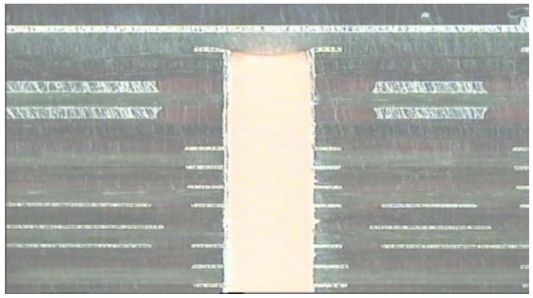
Type II constructions have the same number of HDI layers as Type I: has two buried vias in the core substrate formed prior to applying the HDI dielectric layers. Both vias connect layer 2 to layer n-1; the buried via on the left is filled with HDI dielectric resin: completed filling is guarantee with vacuum press; the right one is filled with different resin, this operation can be made using resin from Peters or Taiyo. Like in these photos, in this way is possible to laser drill over the pad that is plated and reduce space during the design.











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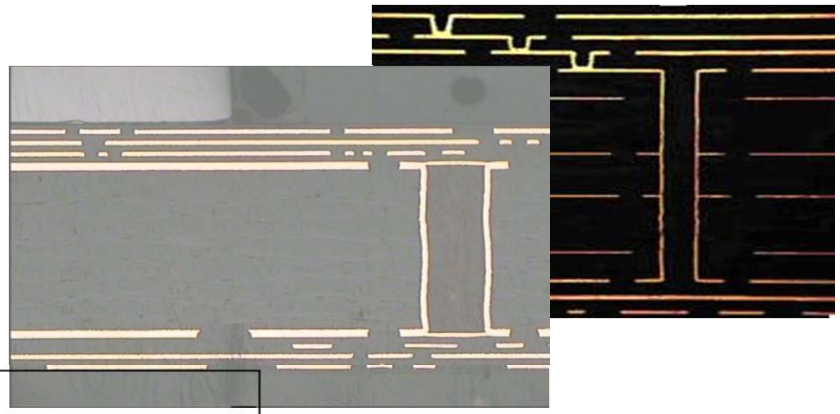
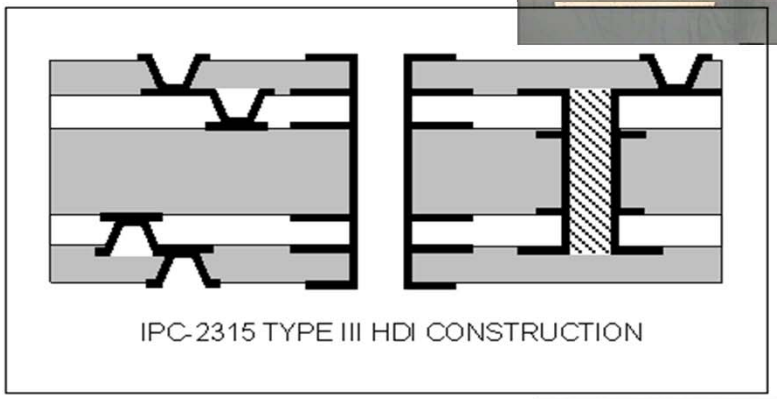
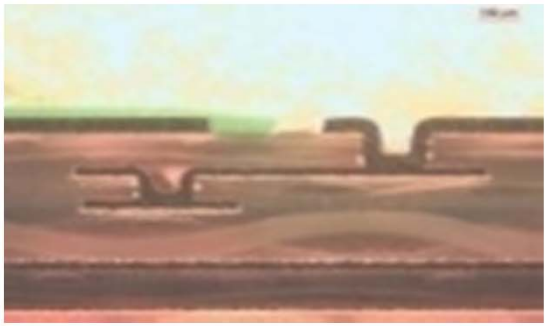
Sequential Build up X+N+X

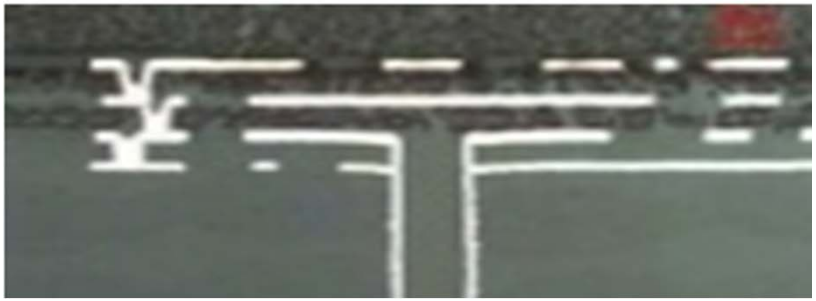
Type III constructions describe an HDI in which there are plated microvias, paste/resin filled holes and through vias used for interconnection. Type III constructions are distinguished by having at least two microvia layers on at least one side of a substrate core. The sub-strate core may be rigid or flexible, and have as few as one or as many as any number of layers with buried vias.







Special redesign made with customer approval to eliminate copper filling technology working on the design parameters: the captive pad for laser via have a different shape definfed to be able to manage two vias



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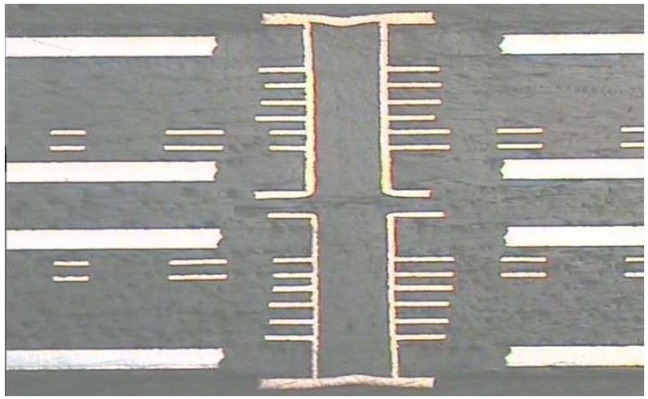
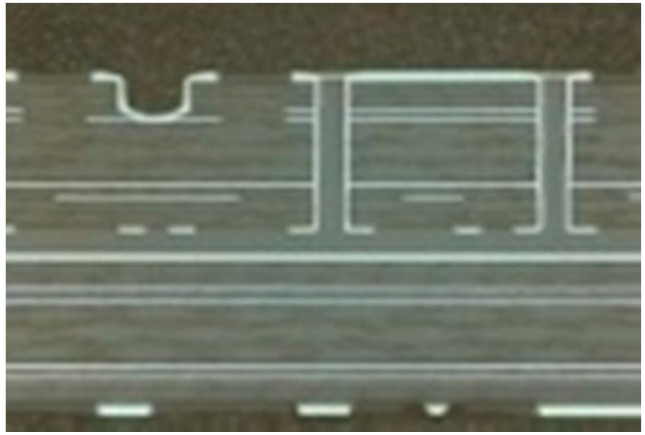
Other Build up options for HDI



These layup are examples of multilayer with double construction.

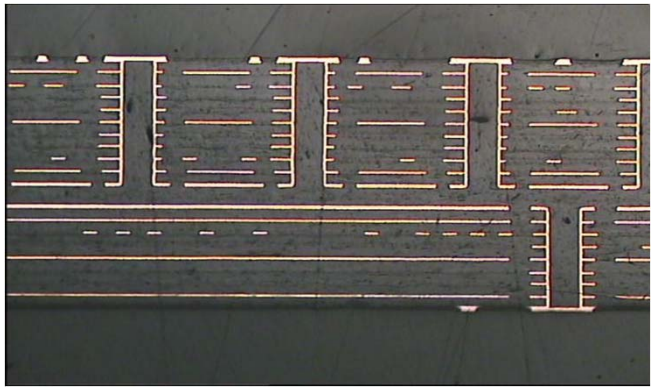
Multilayer board with double blind vias, 20 layer:

- Lay up board with 4 Copper/Invar/copper layer;
- 2 stack up board with capped vias on both side;
- Polyimide construction for avionic application;



Multilayer board 12 layer, High TG material :

- 2 stack up board with capped vias on one side;
- Drilled blind vias;
- Iteq IT180 construction for Military application;



Multilayer board with double blind vias, 20 layer:

- 2 stack up board with capped vias on both side;
- all Nelco N4000-13 construction for Telecom application;

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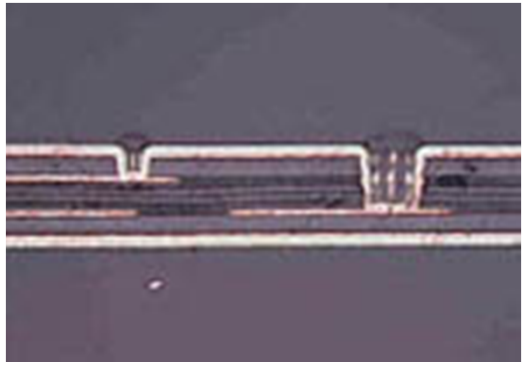
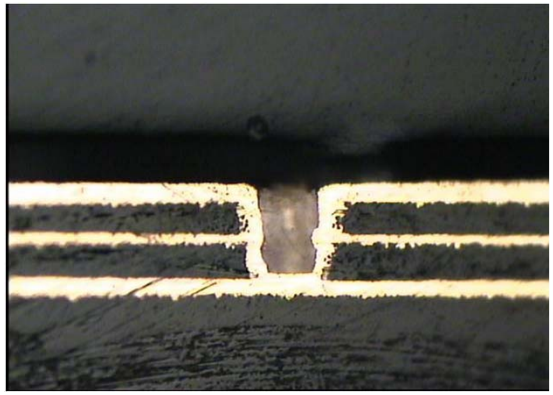
...when we talk about holes...

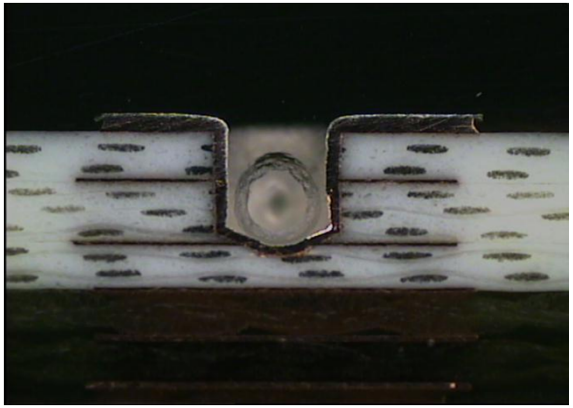
Sequential build-up 4 layer Rigid Flex:
Laser vias from layer 1 to layer 2: 75μm;
Laser vias from layer 1 to layer 3: 125μm;
Insulation Layer: Rigid 60um-Kapton 75μm;



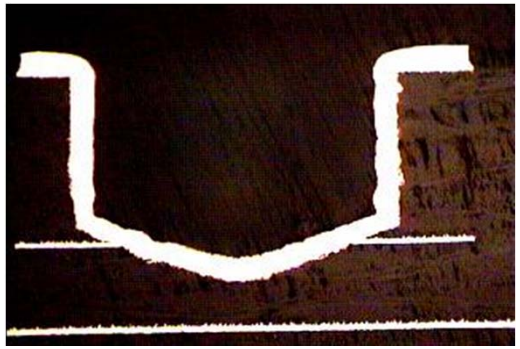
Sequential build-up 2+n+2; Laser vias from layer 1 to layer 3:125μm;
Insulation layers 2x60μm;



Sequential build-up 4 layer Rigid Flex:
Blind Vias mechanically made on mixed Layup Boards: Ro4350+High TG material



Blind Vias mechanically made 500μm on Mid TG Material, for heat dissipation in High performance Power Supply

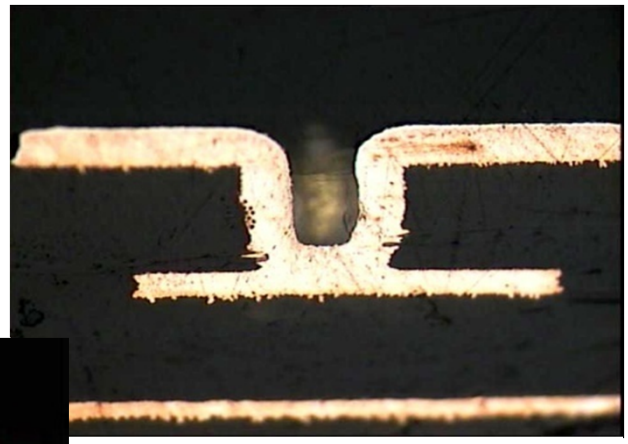


CISTELAIER

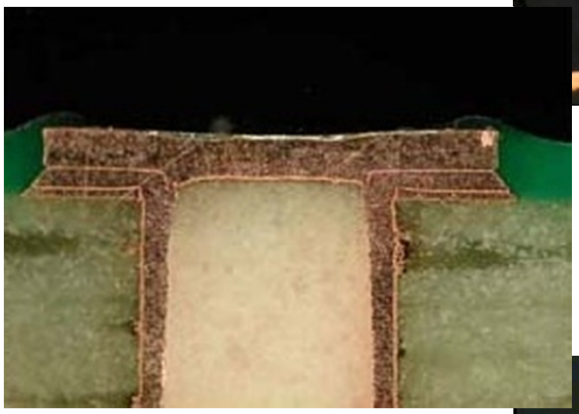
Microvias: different technologies with advantage and disadvantage

Blind μVias laser 100μm:

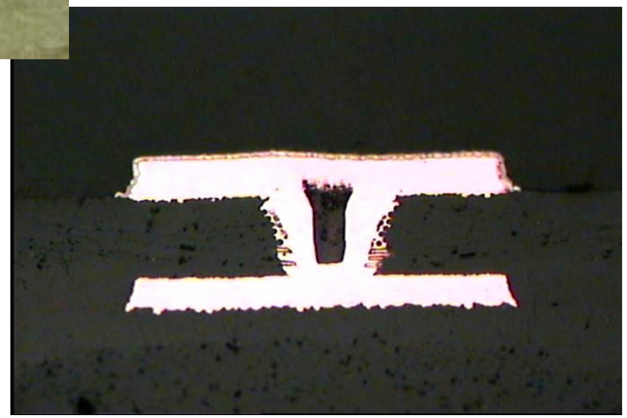
Standard construction with high reliability on all different kind of material that we are able to work:
Advantage: Increase density, reduce pcb dimension and weight
Disadvantage: the risk during assembling of entrapped air under the balls in case of "Via in Pad"



Capped vias on PTH filled with Taiyo TH100DX1 HTG planarized and overplated:
Advantage: Via in pad secure construction;
Disadvantage: multiply drilling and plating process and reduce fineline ability on external layers



Blind μVias laser 100μm, resin filled and planarized and overplated:
Avantage: Increase density, reduce pcb dimension and weight;
Disadvantage: multiply drilling and plating process and reduce fineline ability on external layers. Also the resin filling process can't assure the unpresence of air bubble in the vias



..... but there is a solution .....

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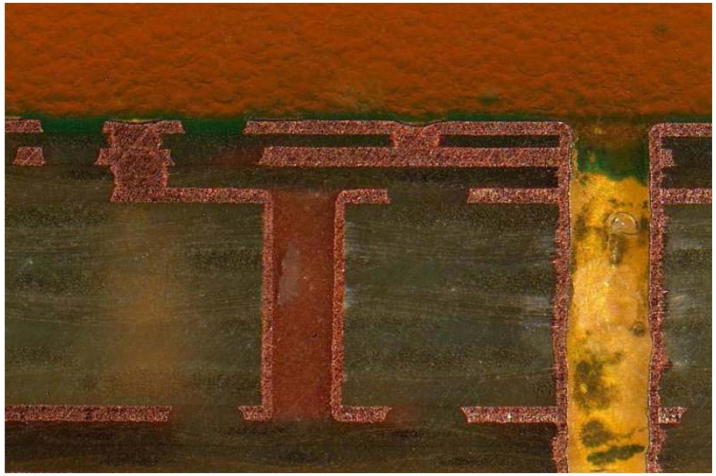
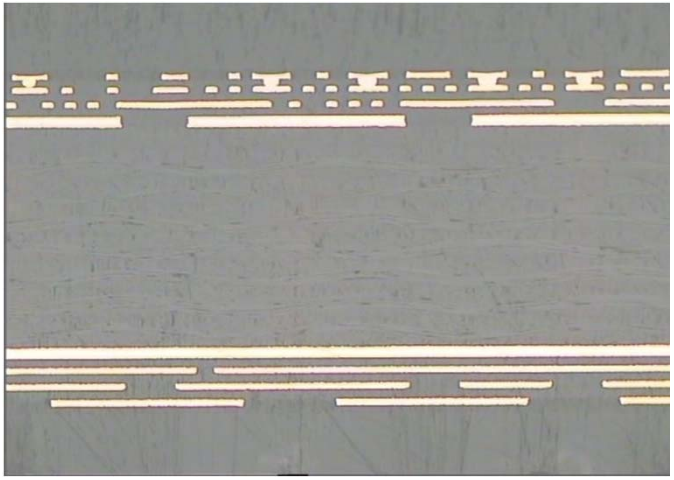
Copper filling

Demanding for this finishing is growing; Cistelaier installed a specific designed tank for copper via filling process. Mainly this technology is used for filling hole in sequential build up structure with stacked vias. **Advantage:** Planar surface for Via in pad design, no air entrapment and better signal & power integrity; **Disadvantage:** if not correctly designed in the ratio between via diameter, layout balance and dielectric thickness this technology can give problem with extra fine line design due to the excessive plating process on the surface

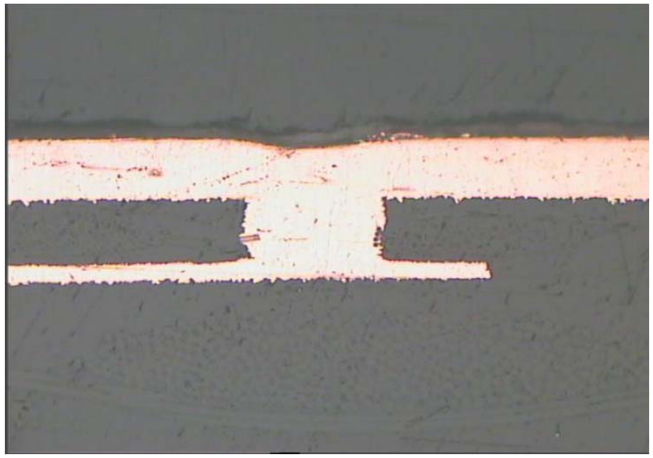
Blind μVias laser 75μm copper filled, stacked vias and burried vias



Blind μVias laser 100μm on High TG Material, copper filled: SBU 3+N+3



Blind μVias laser 100μm on High TG 75μm, copper filled



CISTELAIER

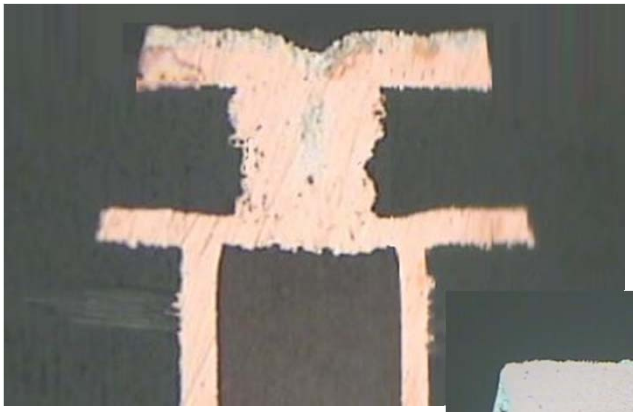
Capped Vias …. More info!

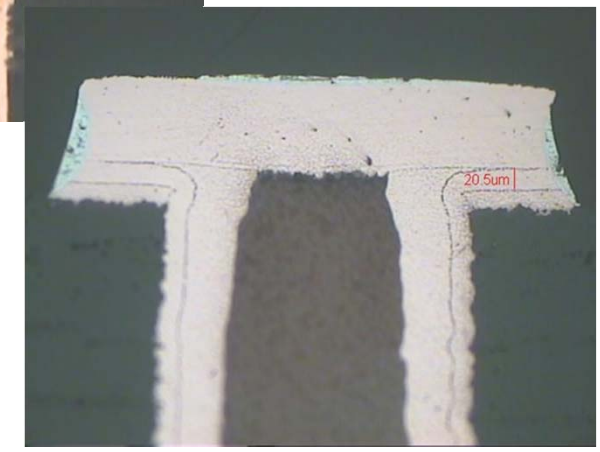
Demanding for this technology is growing; Cistelaier installed a specific machine for via filling process. Mainly this technology is used for filling hole in plated through hole and sequential build up structure with stacked vias.

Advantage: Planar surface for Via in pad design, no air entrapment and better signal & power integrity;

Disadvantage: multiply drilling and plating process and reduce fine line ability on external layers

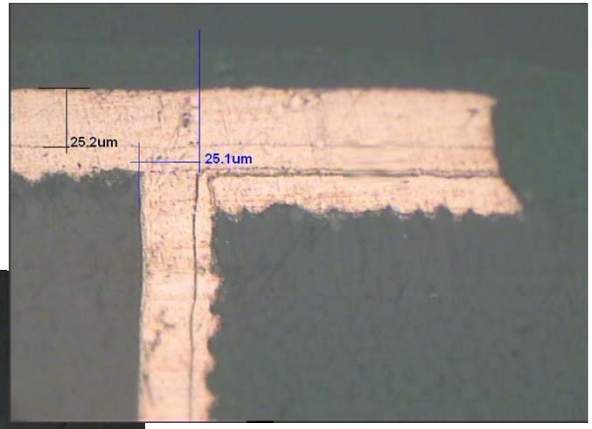
Blind µVias laser 75µm copper filled, stacked vias on capped burried vias

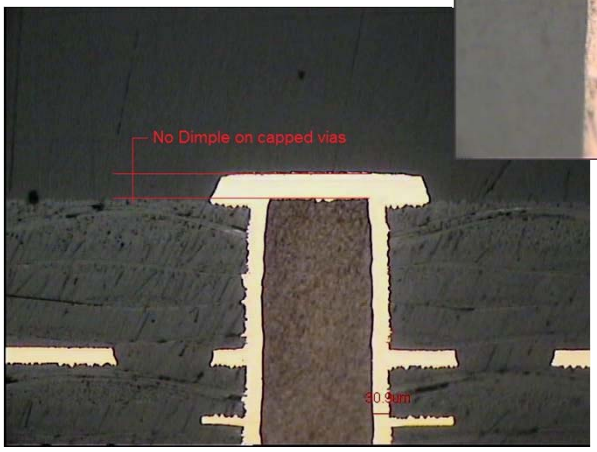




Wrap Thiockness >12 µm to garantee good performance

Capped thickness: >15 µ m as typical value



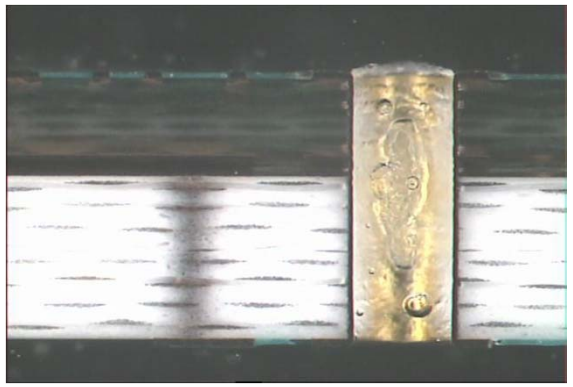


Dimple value <18 µm to garantee good planarity, but target is "ZERO"

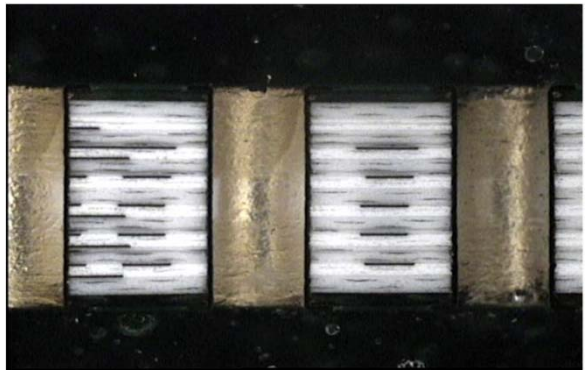
CISTELAIER

...some mixed layup...

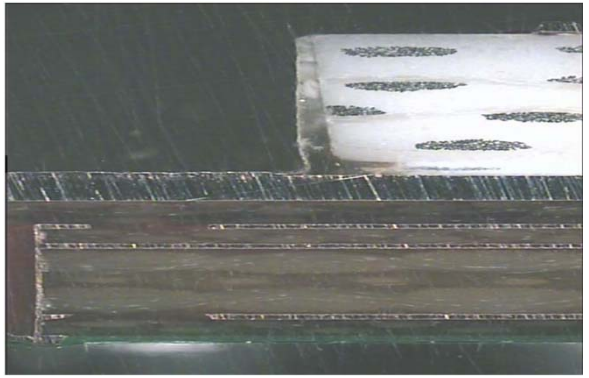
Mixed Build-up 8 layer :
Iteq IT180;
Rogers RO4450;
Rogers Ro4350;



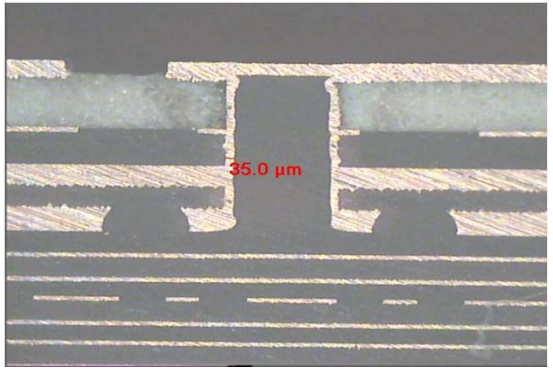
Multilayer 12 Layer:
Full Arlon 25N
Different surface finishing: selective soft gold and Enig



Sequential build-up 6 layer :
Blind Vias mechanically ;
Layup Boards: Ro4350+Invar+ Polyimmide Arlon 35N



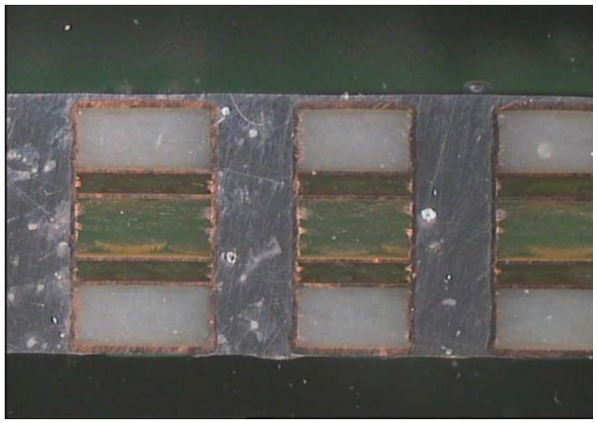
Mulitlayer 14 layer:
Iteq It180 + Taconic RF35A2
Different drill sequence: 1-2; 1-4; 1-12 and pth.
Via resin filled and capped



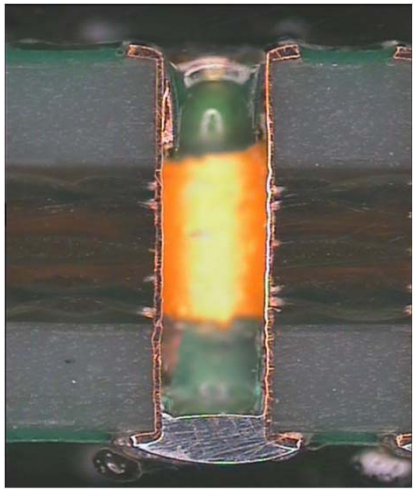
CISTELAIER

...some mixed layup(2)...

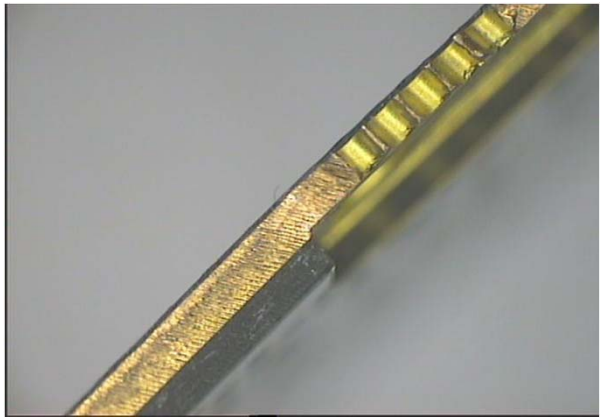
Mixed Build-up 6 layer :
Arlon 35N;
Arlon 37N No flow prepreg;
Rogers RT6000 on the 2 outer layer;



Mixed Build-up 6 layer :
Arlon 35N;
Arlon 35 prepreg;
Rogers Ro3000 on the 2 outer layer



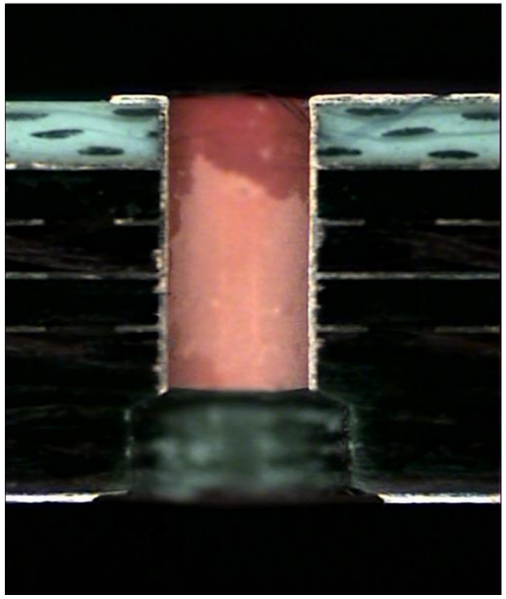
Mulitlayer 6 layer:
Arlon 35n + Taconic RF35A2
Cavity Z-Axis Routed



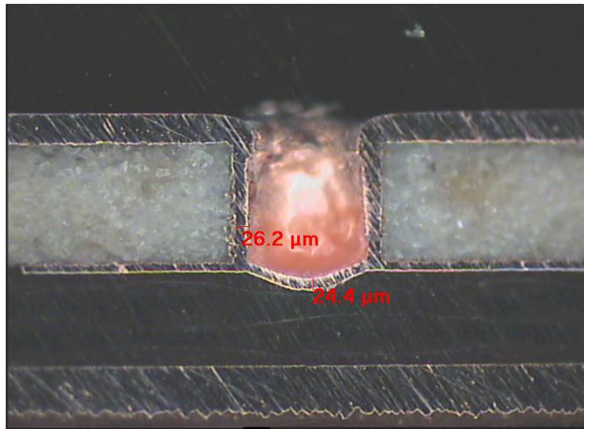
CISTELAIER

...and about other holes(2)....

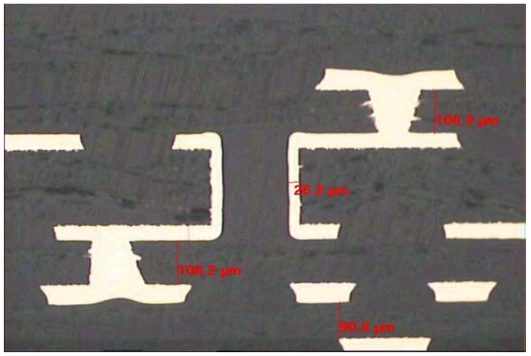
Sequential build-up 6 layer Rigid :
Iteq IT180;
Rogers Ro4350;
Backdrilling to solve warp effect;

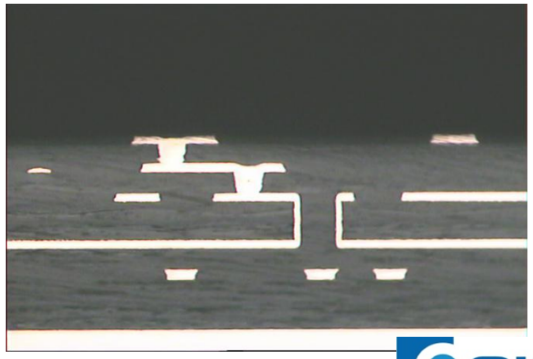


Blind Vias mechanically made on
Taconic RF35A2 material in 14 layer pcb
with mixed layup



Sequential build-up 2+BV+1:
Laser copper filled
Burried vias





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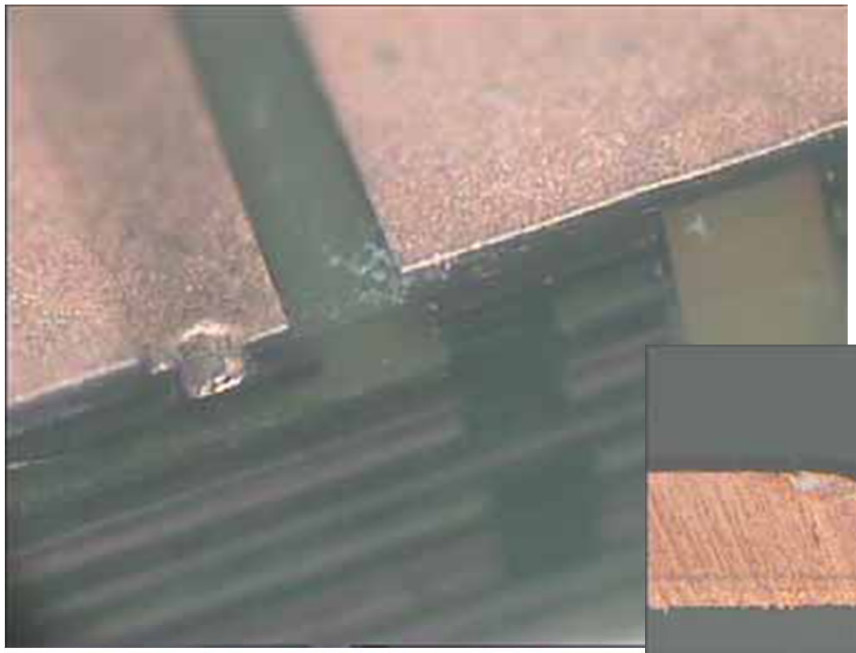
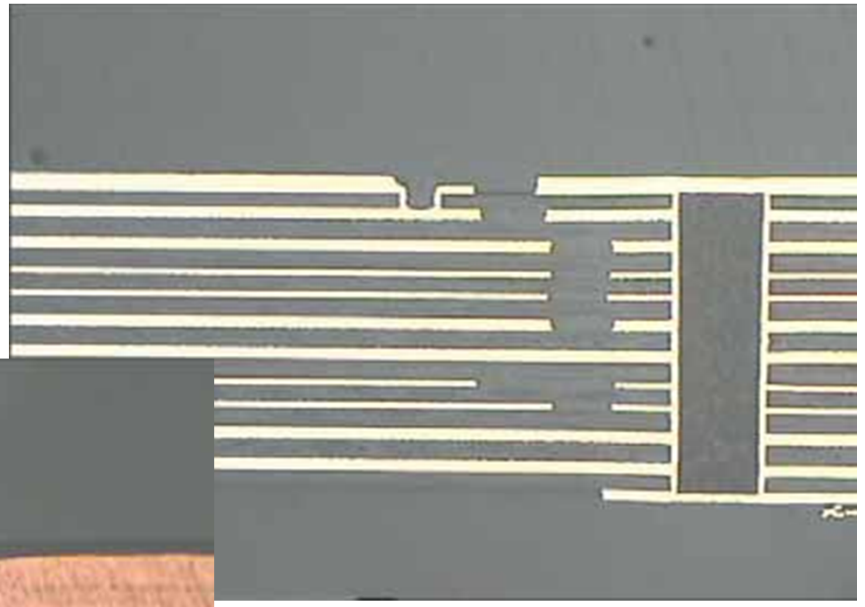
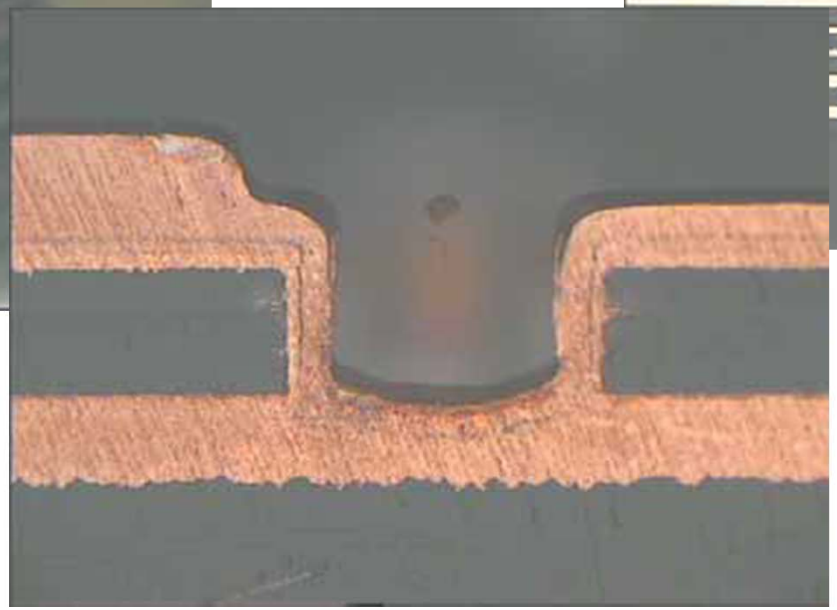
...and different thermal dissipation pad design!





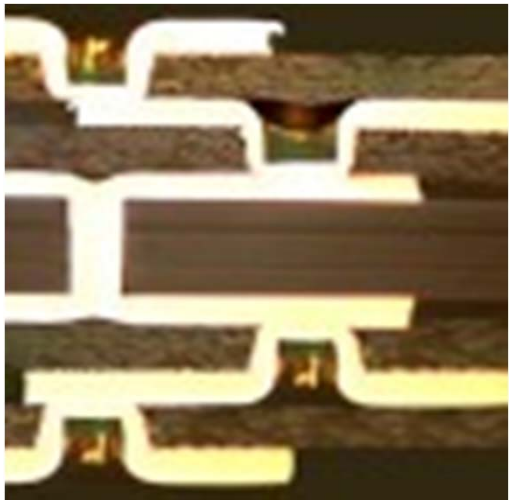


COB project for avionic application: 12 layer board with different copper thickness on same side for Die heat dissipation with blind µVias laser 100µm on High-TG Material; some through holes are filled with high TG epoxy resin and planarized and overplated with 80 µm Cu; tolerance on planarity for capped vias +/-12 µm.

CISTELAIER

Flex-Rigid in HDI applications

This Rigid flex, for Medical application, is a 6 layer board with double sequence of laser via and burried vias on flex material:
Line 75 µm
Space 75 µm
Laser Vias 100 µm
kapton Ap8525-17Cu/50K/17Cu
High TG material. TG 180°

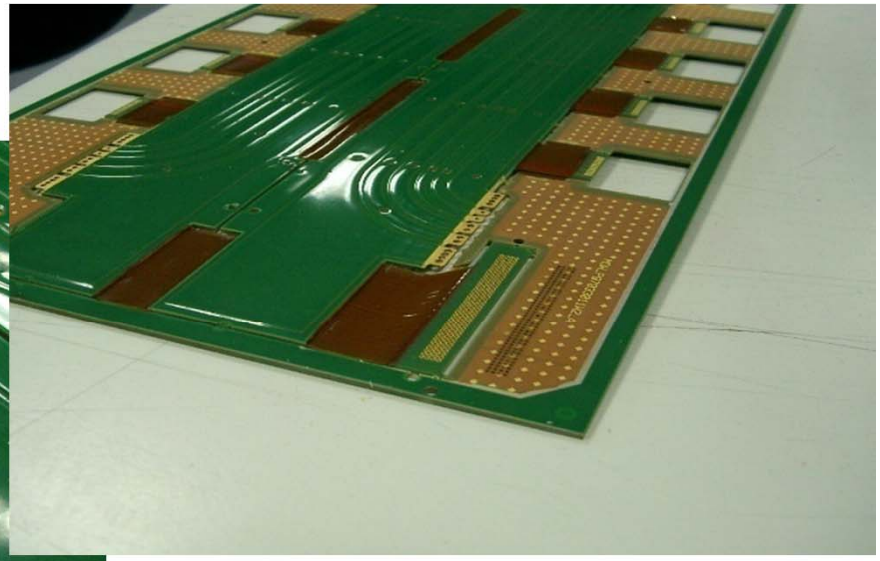


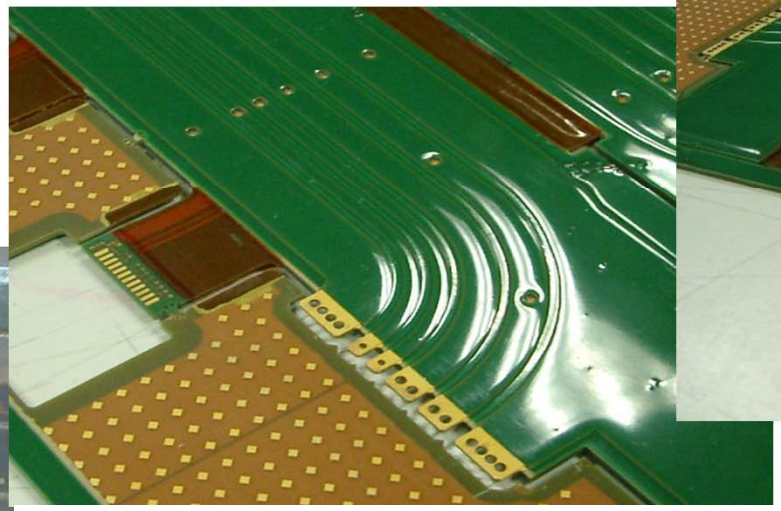
This Rigid flex, for Military application, is a 8 layer board with laser via and burried vias:
Line 75 µm
Space 75 µm
Laser Vias 100 µm
2 x kapton Ap8525-17Cu/50K/17Cu
Polyimmide base material TG 250°

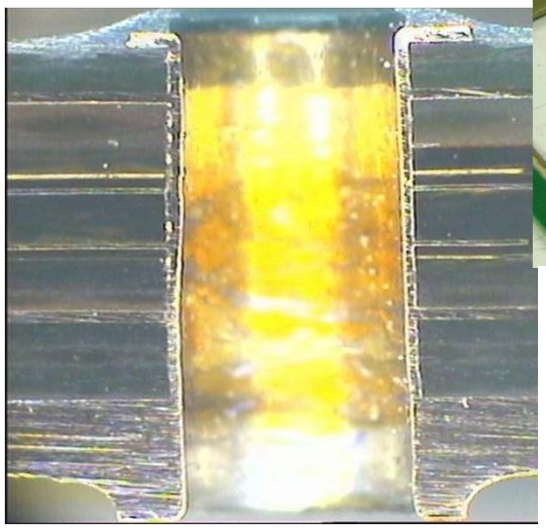
CISTELAIER

HDI Flex-Rigid ... not always small

This Rigid flex is a 9 layer board with buried and blind vias for Military Radar application; this boards is long 865mm and 4 layer, on flex material, have impedance line with 10% of tolerance; there is also an integrated 500μm Copper BusBar for power distribution.
Only copper lines come out from pcb border for a direct connection and soldering.







Main Characteristics:

- 9 Layer Rigid Flex - Kapton Adhesiveless+ High TG Laminates;
- Burried vias 150μm on inner layer; Blind Vias on BusBar 200μm;
- Impedance controlled track: 6 Mils on long side of board (865 mm)

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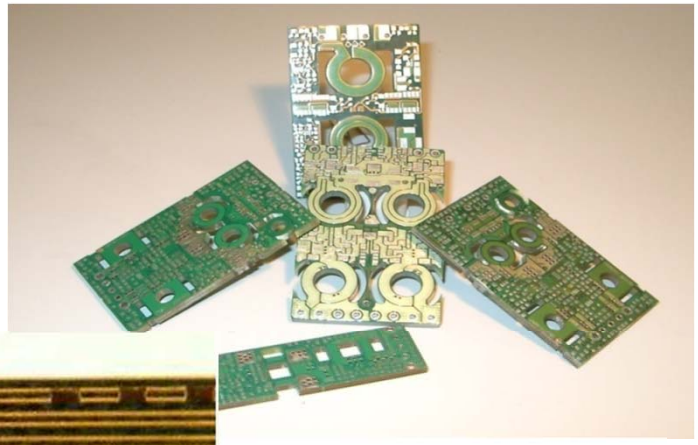
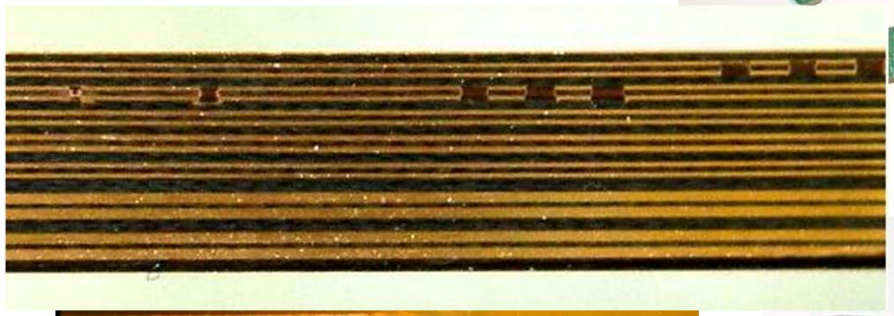
High Frequency & High Power

All modern power supply, DCDC converter , are now the best example for HDI application in power modules.
To maximize the the power is usually used a fully buried vias layup, both for planar and inductors planar design need, both to minimize the space using via in pad



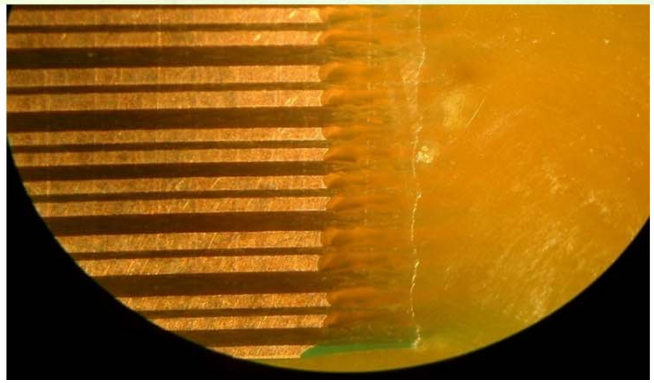
Multilayer board, 16 layer for DC-DC Converter :

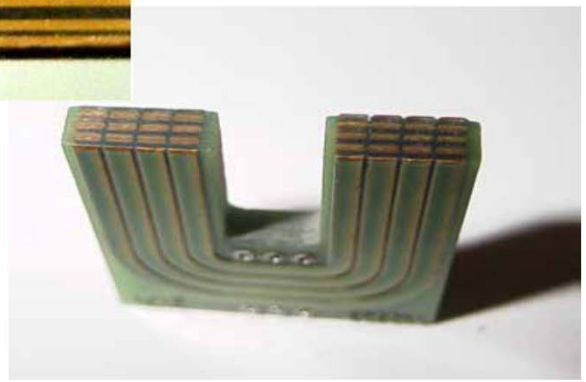
- Heavy copper:3 and 6 Oz;
- High TG material
- Buried vias



Multilayer board, 14 layer for Planar transformer application:

- 2 Heavy copper layer 5 and 6 Oz;
- High TG material





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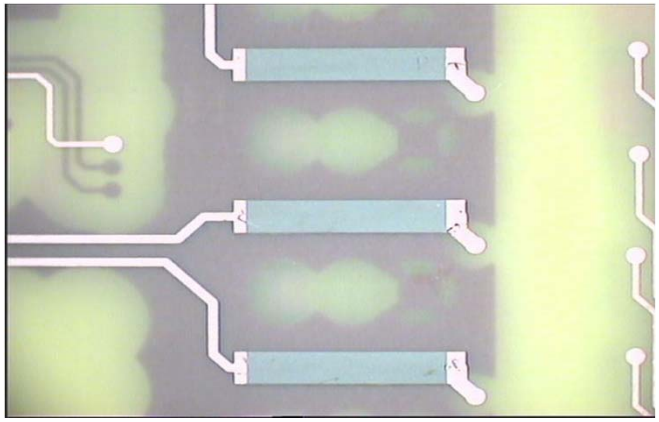
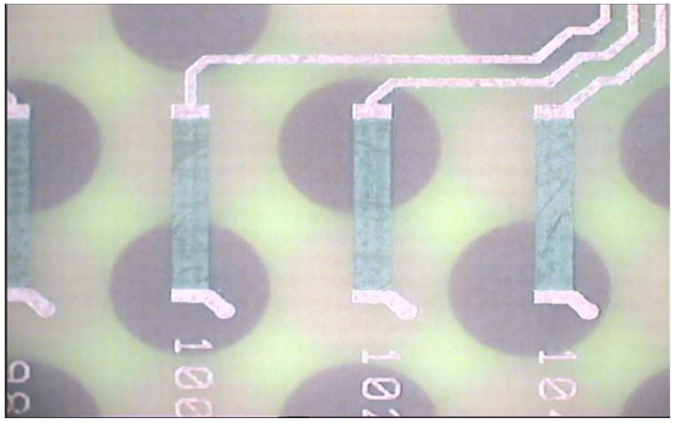
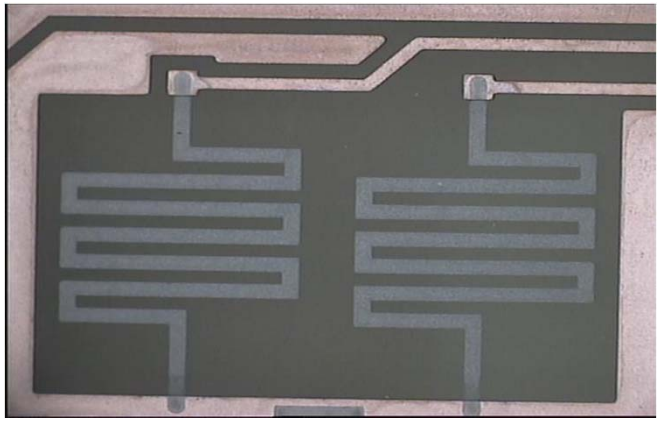
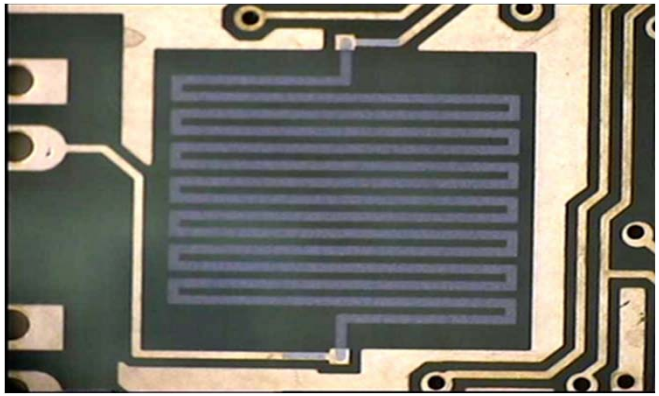
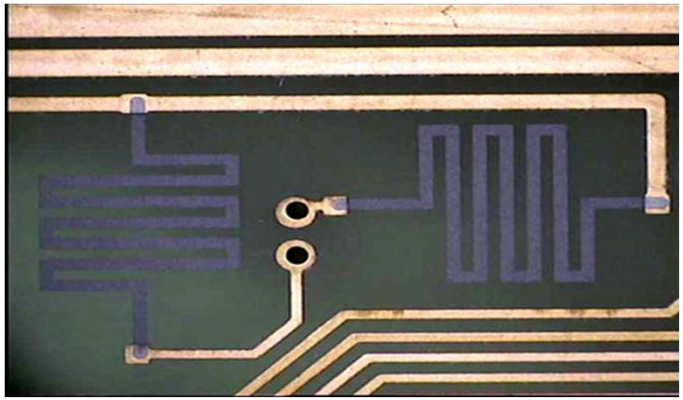
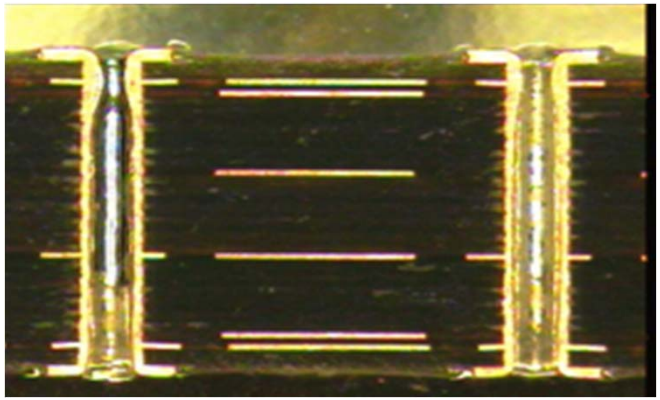
Future Trends - Embedded Components

Our R&D team works on several different project from 2003 with Capacitance layer and Resistance layer; there is a lot of interest on this technology, but there are some limitation at the moment for Resistance embedded:

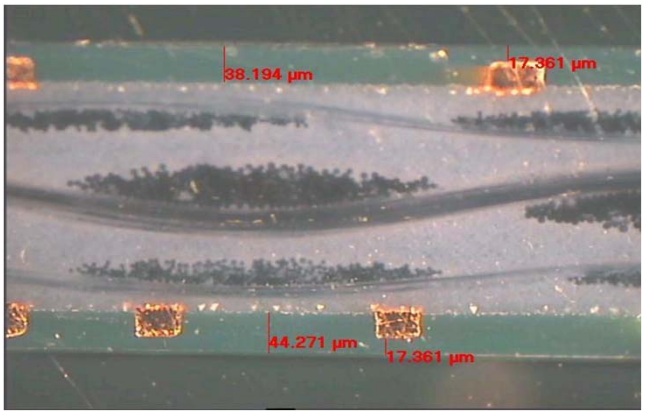
- Few software able to manage the embedded resistor;
- PCBA can't be repair anymore;
- Resistance Tollerance very high (+/-20-25%)

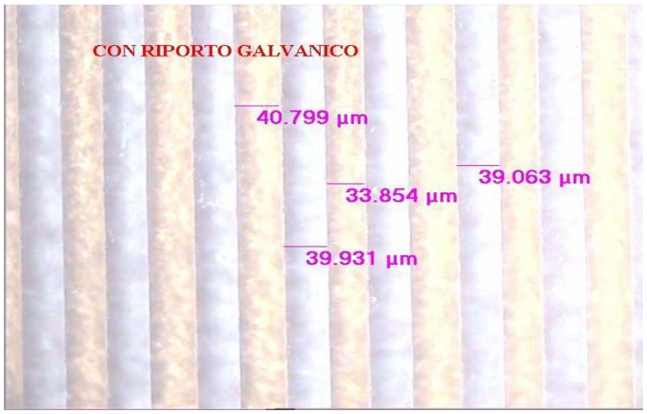
Future Trends – Line & Dielectric reduction

Our R&D department is hardly working on reduction of line/space and mixed layup structure with inside low thickness prepreg to minimize aspect ratio for total sequential build up.

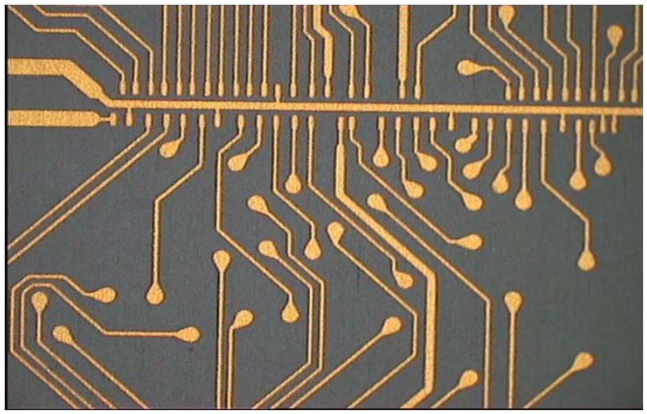
Outlayers
Plated Lines 1.5mils on



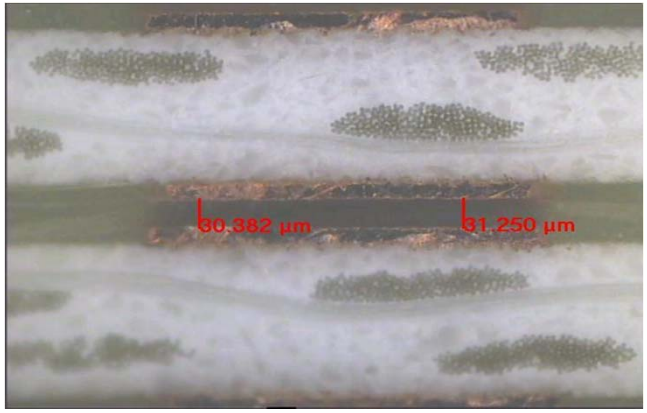
Outlayer
Plated Lines/Space 40µm



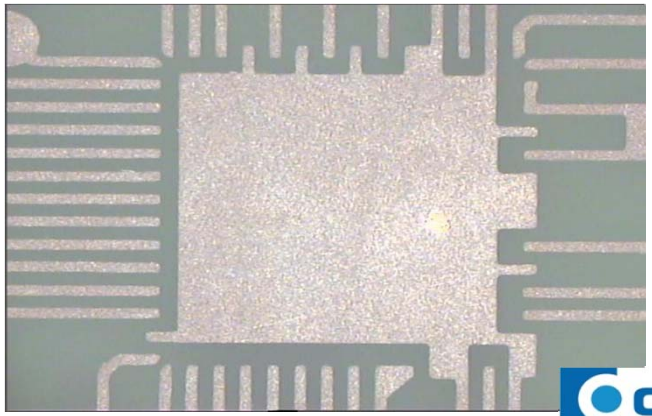
Outlayer - On Fully SBU
Plated Lines/Space 1.5mils



Low Dielectric
Thickness 30µm



Component
Footprint 50µm



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Any question?

For any additional question or explanation I'm at your disposal during all coffee break, with possibility to show also example of products from different technologies.

If you need a copy of this presentation please leave me you business card and you will receive this presentation and an extended one with more information about Cistelaier and others company of FinMasi Group.

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Thanks for your attention.

For any additional needs, please contact us:

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