Optiprint

Innovative PCB Solutions

PWB interconnect solutions inc.
IST testing systems and services

Polar Instruments

Sichern der Zuverlässigkeit für Leiterplatten mittels Interconnect Stress Test

Zeitbeschleunigt

→ optiprint.ch

Optiprint AG - Facts

- Established 1985
- Located in North-East Switzerland
- Privately-owned, managed in 2nd generation
- 130 employees, low fluctuation rate < 3 %
- Prime products; high-end RF/microwave / mm-Wave & HDI flex / flex-rigid PCB
- Continuous investment in plant & equipment (≈ 10% of turnover)
- State-of-art kit in all process stages, key being machining, imaging, etching, lamination, electrical test & metrology
- Clean, modern facility

Company Milestones

1985 — foundation

1998 — new facility

2000 — facility extension

2012 — first generation

second generation

Industries

With an export share of about 80 % Optiprint AG supplies the following markets:

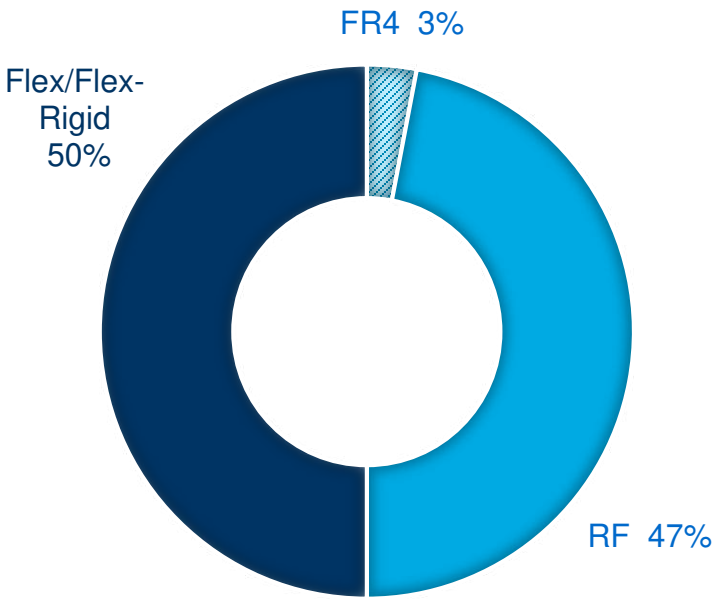
Medical technology

Telecommunication

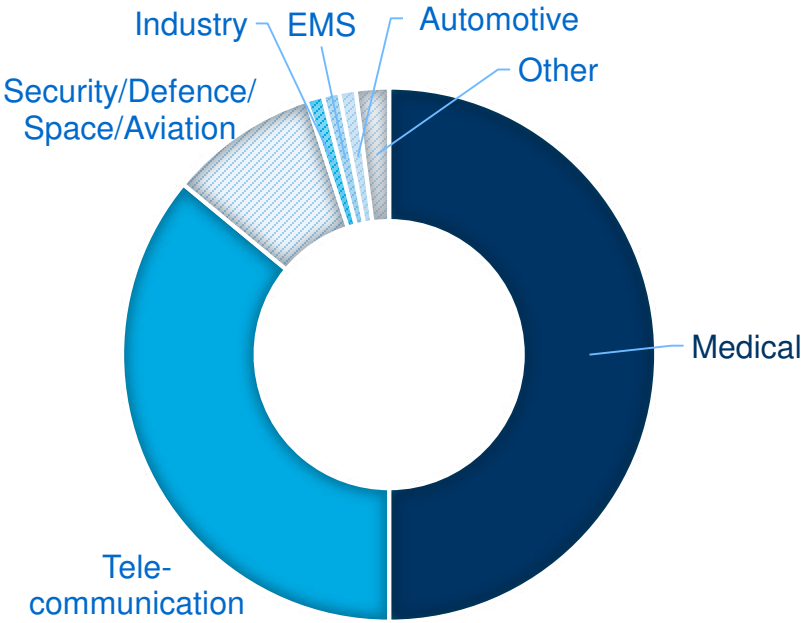
Safety technology

Aerospace

Products - Markets



PRODUCTS



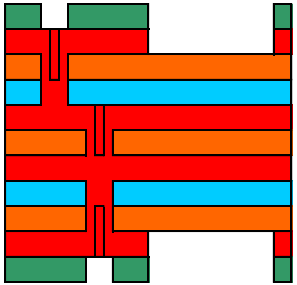
MARKETS

Trends in the PCB industry

- Miniaturisation
- Modularisation / Integration
- New processes
- New laminate materials (next gen.)
- New surface finishes (e.g. DIG)
- …

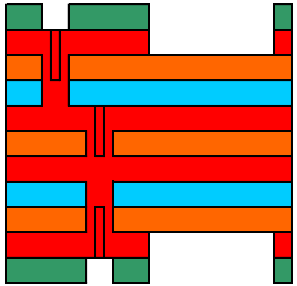
Miniaturisation

Build-up



Soldermask	0.020
Copper	0.022
Polyimide	0.012
Adhesive	0.025
Copper	0.022
Polyimide	0.025
Copper	0.022
Adhesive	0.025
Polyimide	0.012
Copper	0.022
Soldermask	0.020

Thickness: 0.210mm



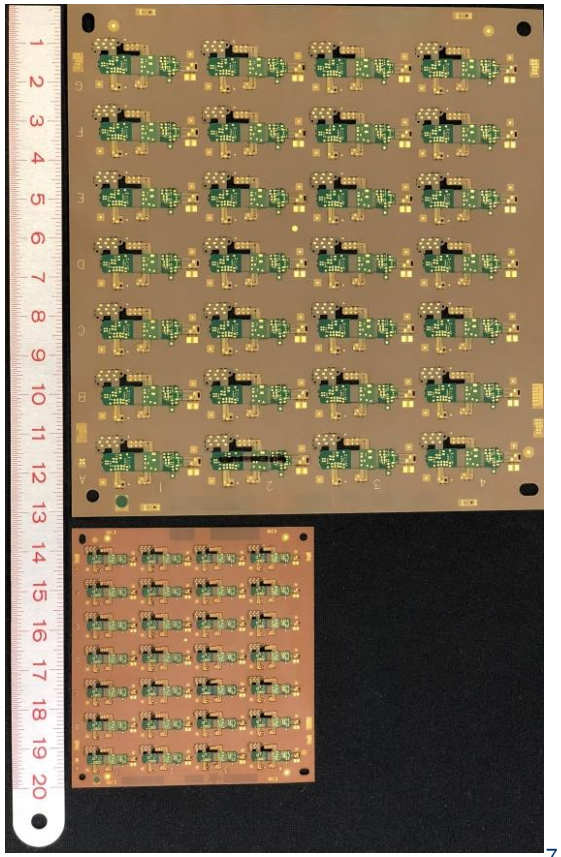
Soldermask	0.015
Copper	0.015
Polyimide	0.012
Adhesive	0.012
Copper	0.015
Polyimide	0.012
Copper	0.015
Adhesive	0.012
Polyimide	0.012
Copper	0.015
Soldermask	0.015

Thickness: 0.135mm

Design Rules

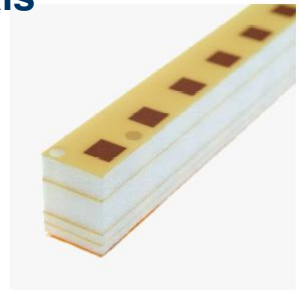
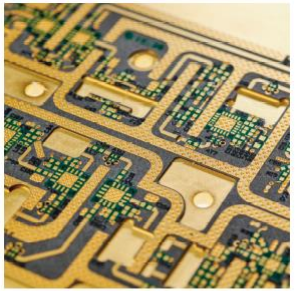
Line / Space	75 / 75 µm
Via Ø	75 µm
Pad Ø	200 µm

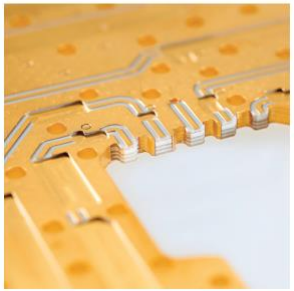
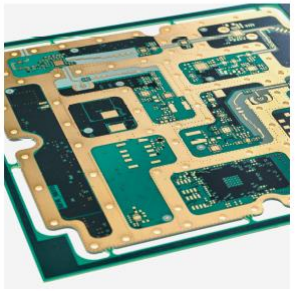
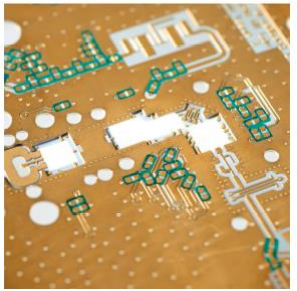
Line / Space	38 / 38 µm
Via Ø	25 µm
Pad Ø	100 µm



High frequency PCBs

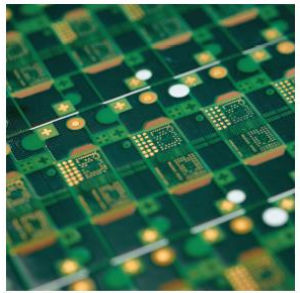
- high stock level of different RF-materials
- high etching accuracy
- PTFE, ceramic, foam
- burried / filled / overplated vias
- stacked microvias
- trough hole filling (Cu or epoxy)
- metal core PCB
- integrated heatsink
- integrated components
- resistive foil

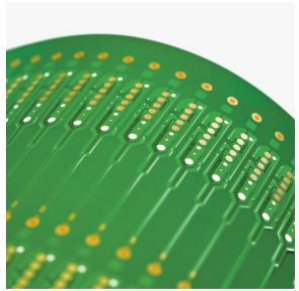
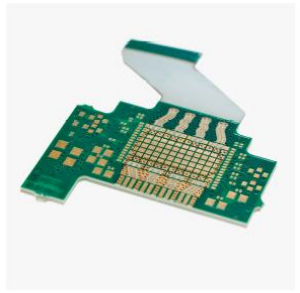
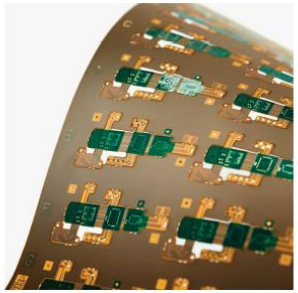



Flexible and flex-rigid PCBs

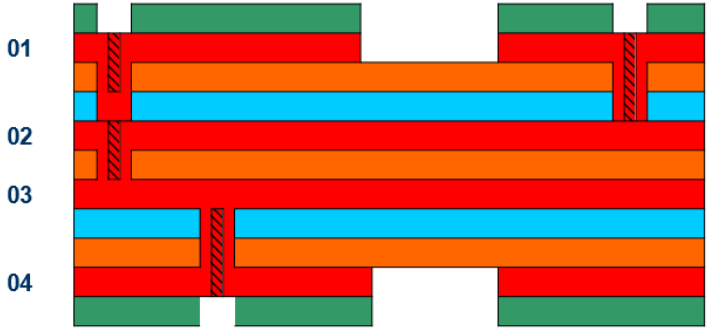
- very fine line / space (<25µm)
- very thin laminates
  - 12µm PI core
  - 4 layers = 135µm incl. SM
- filled and stacked microvias
- via in pad
- lasercut outline ± 25µm

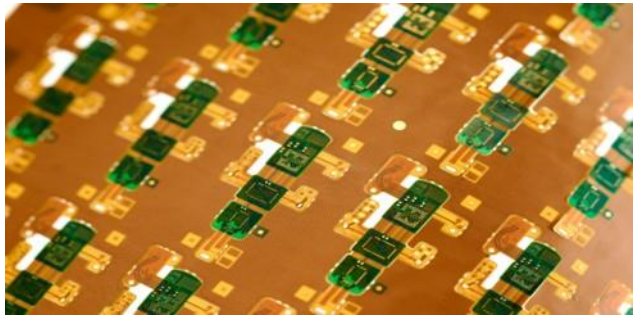



Sample: 4–layer rigid-flex board

- 4-layer full-flex rigid-flex PCB
- Dupont / Thinflex Polyimide
- Board thickness 0.135 mm
- Solder mask defined pads
- Line / space: down to 25 µm
- Copper thickness 8 – 18 µm
- Stacked and Staggered via technology





Surface finish

Properties	ENIG	ENEPIG	ISIG	ENIGEG	ENEPIG	EPIG	DIG	Galv Ni/Au	Chem Ag	Chem Sn
	in-house	in-house	in-house	in-house	external	external	external	external	external	external
Wire Bonding	yes	yes	yes	Yes	yes	yes	yes	yes	no	no
Metal	Ni/Au	Ni/Pd/Au	Ag/Au	Ni/Au	Ni/Pd/Au	Pd/Au	Au	Ni/Au	Ag	Sn
Typical Thickness	Ni 3-7µm Au 0.05- 0.1µm	Ni 3-7µm/ Pd 0.2-0.5µm/ Au ≥0.010	Ag 0.1-0.4µm Au 0.1-0.2µm	Ni 3-7µm/ Au 0.4-1.1µm	Ni 3- 7µm/ Pd 0.08- 0.3µm Au 0.03- 0.08µm	Pd 0.1-0.2µm Au 0.1-0.2µm	Au 0.2–0.3µm	Ni 3-10µm Au 0.1- 10µm	Ag 0.15-0.4µm	0.6-1.2µm

Production Processes

- **Automation**

- **Direct Processes**
  - Inkjet, LDI, 3D Printing

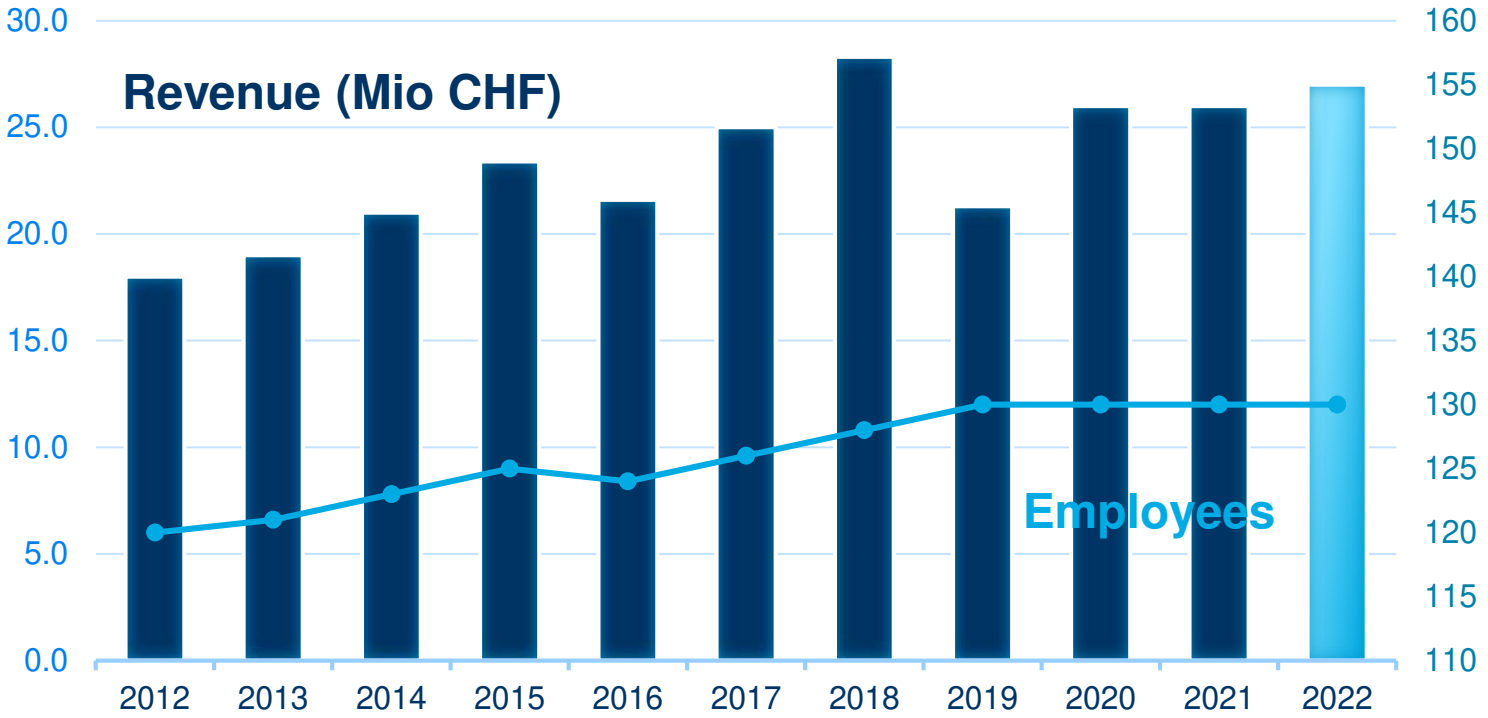
→Traceability

- **Laser tooling**
  - Nano → Pico → Femto

- **More Inspections/Tests (automatic and manual)**




Revenue/Sales - Employees



Anforderungen an die LP nach der Herstellung?

Thermische Belastung bei der Bestückung	Thermische Belastung im Betrieb
Verschiedene Lötprozesse	Temperaturschwankungen • Betriebstemperatur • Ruhetemperatur
Hohe Temp – ab 230°C	
Reparaturarbeiten • 6x Reflow bei 260°C	
Einbau • Statische und Dynamische Biegung	

Überlebensfähigkeit vs. Zuverlässigkeit

Rework Zyklen bestehen wärend der Bestückung → **Überlebensfähigkeit**

Thermische Belastung in der Endanwendung
überstehen → **Zuverlässigkeit**

Testmethoden

Temperaturwechseltest (TWT)

Prüfling wird wechselweise in zwei Klimakammern mit ***–40°C*** und ***+125°C*** eingefahren

IST Interconnect Stress Test

Elektrische Aufheizung des Coupons auf ***150°C*** für 3 Minuten, Abkühlung auf Raumtemperatur in 2 Minuten

The Institute for Interconnecting and Packaging Electronic Circuits
2215 Sanders Road Northbrook IL 60062-6135

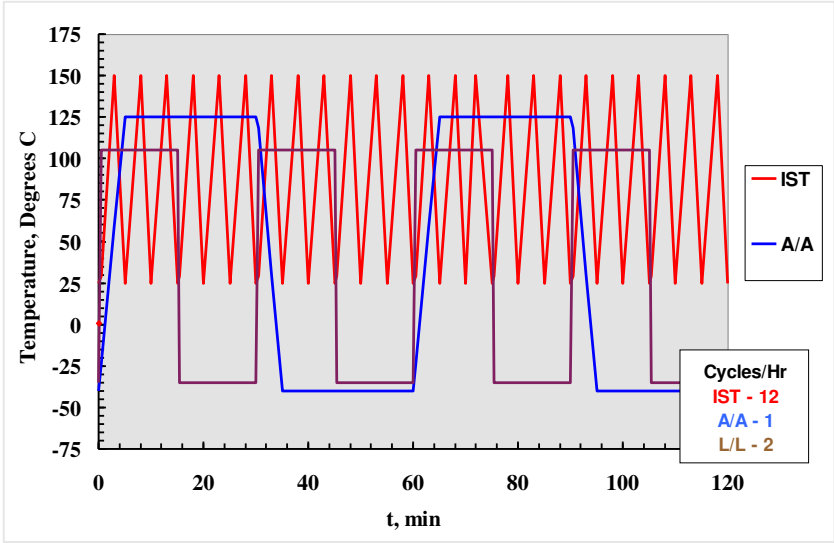
IPC-TM-650
Test Methods Manual

Number 2.6.26	
Subject **DC Current Induced Thermal Cycling Test**	
Date **11/99**	Revision **Proposal**
Originating Committee: Test Methods Subcommittee (7-11)	

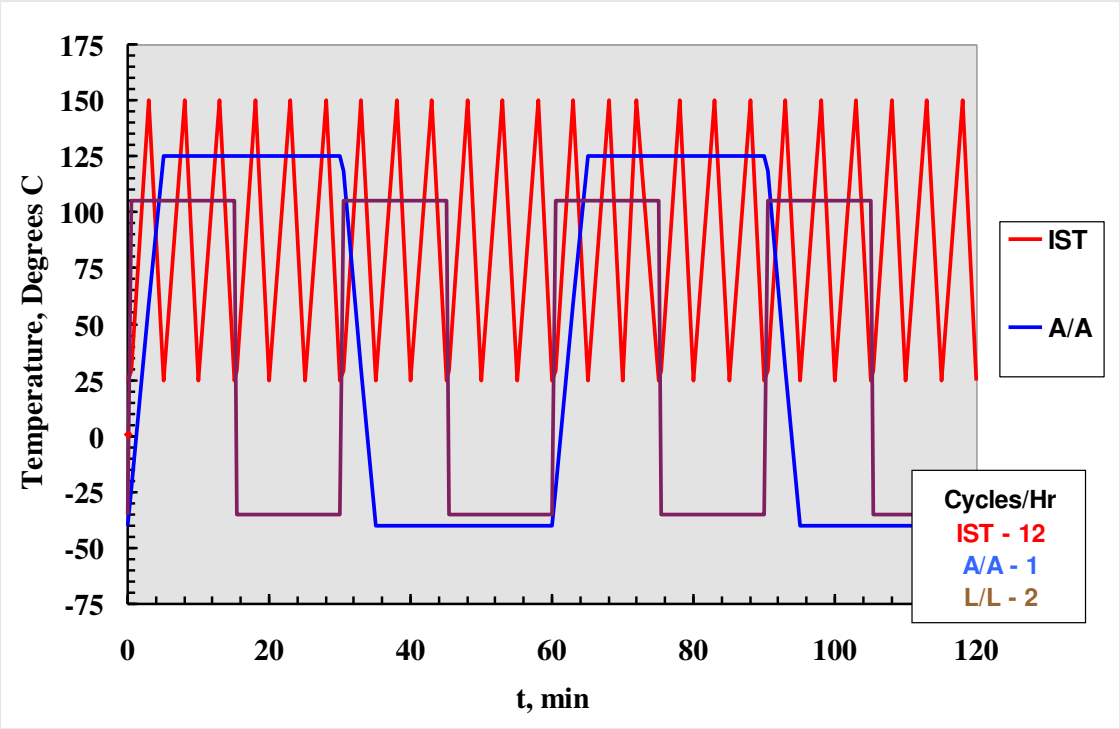
Vergleich TWT vs. IST

- TWT testet in Negativtemp. **mit** Verweilzeit
- IST testet ab Raumtemp. **ohne** Verweilzeit

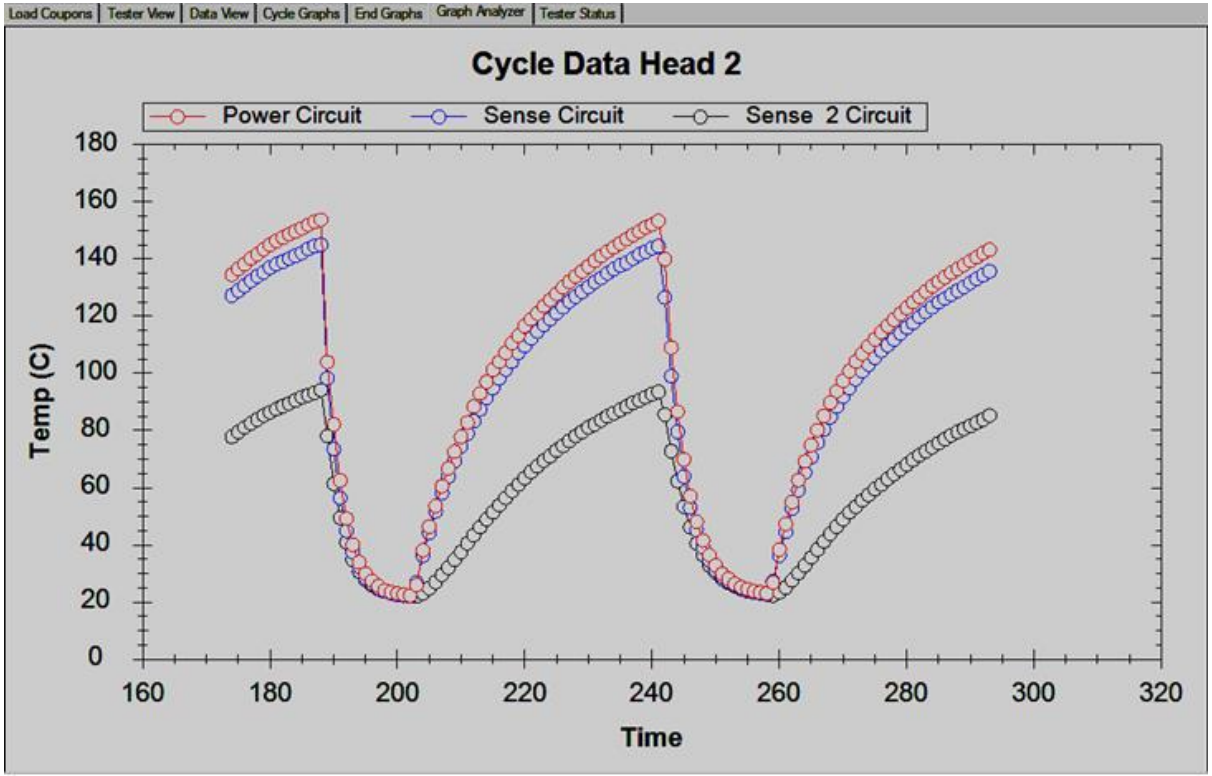
→ Deutlich kürzere Zykluszeiten



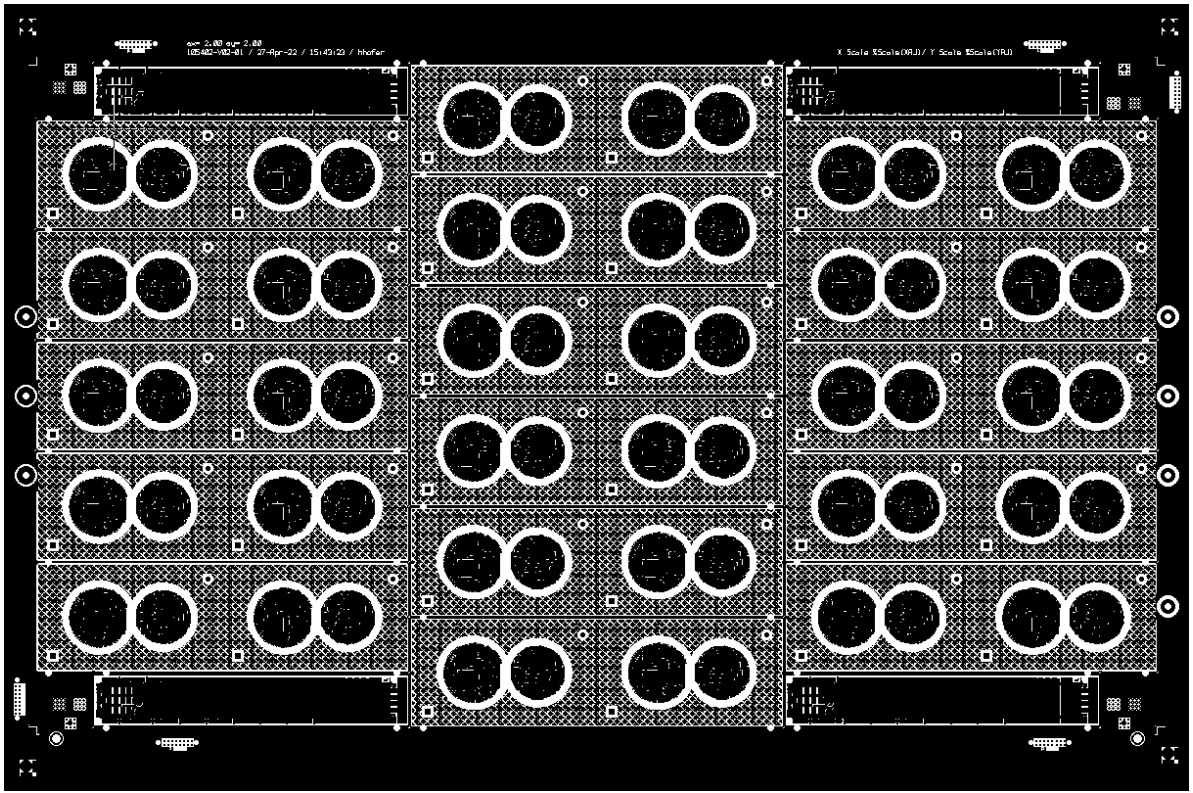
Vergleich TWT vs. IST



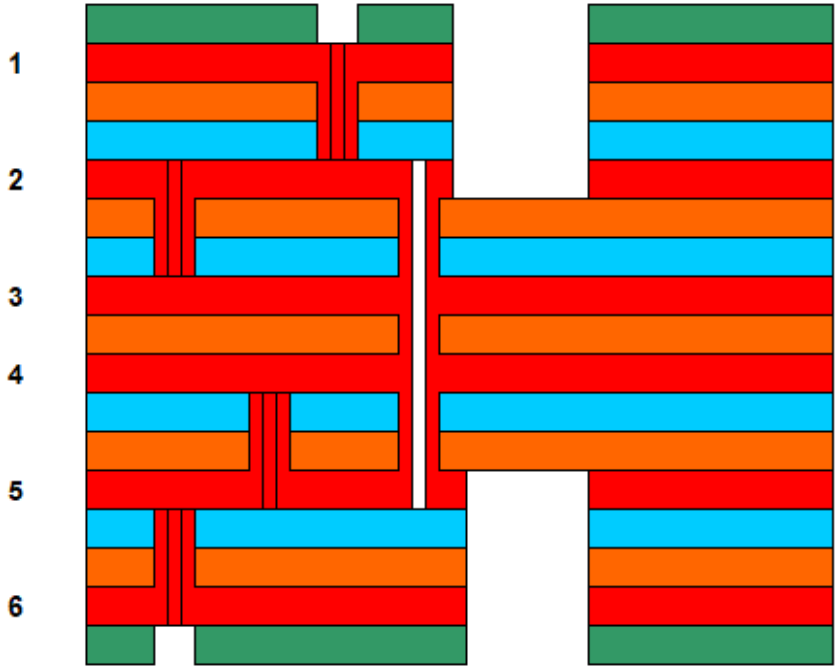
Temperaturverläufe am Coupon



Positionierung im Panel

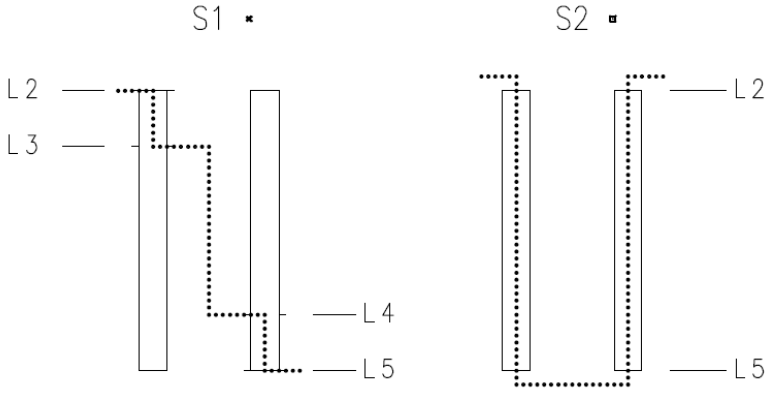


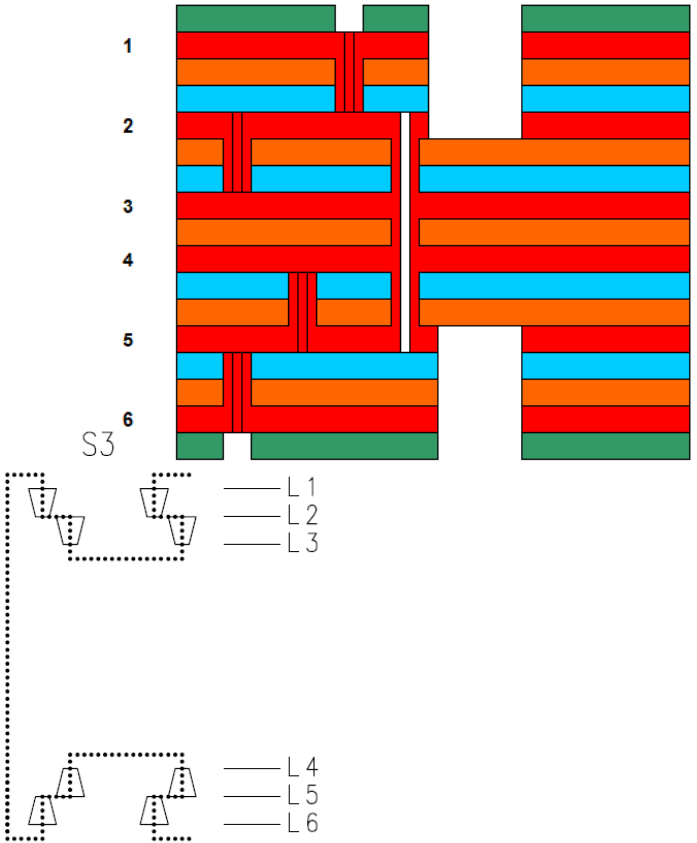
6-Layer with buried and staggered vias



Soldermask	
Cu	0.025
Polyimide	0.050
Adhesive	0.025
Cu	0.020
Polyimide	0.012
Adhesive	0.025
Cu	0.012
Polyimide	0.025
Cu	0.012
Adhesive	0.025
Polyimide	0.012
Cu	0.020
Adhesive	0.025
Polyimide	0.050
Cu	0.025
Soldermask	

Messkreise im Coupon





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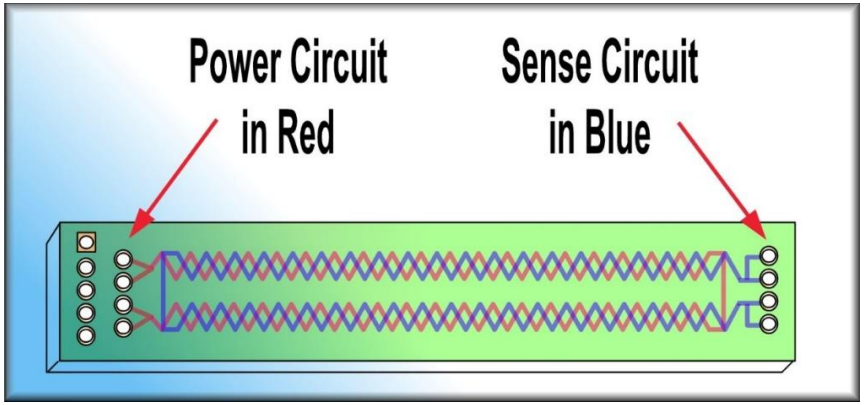
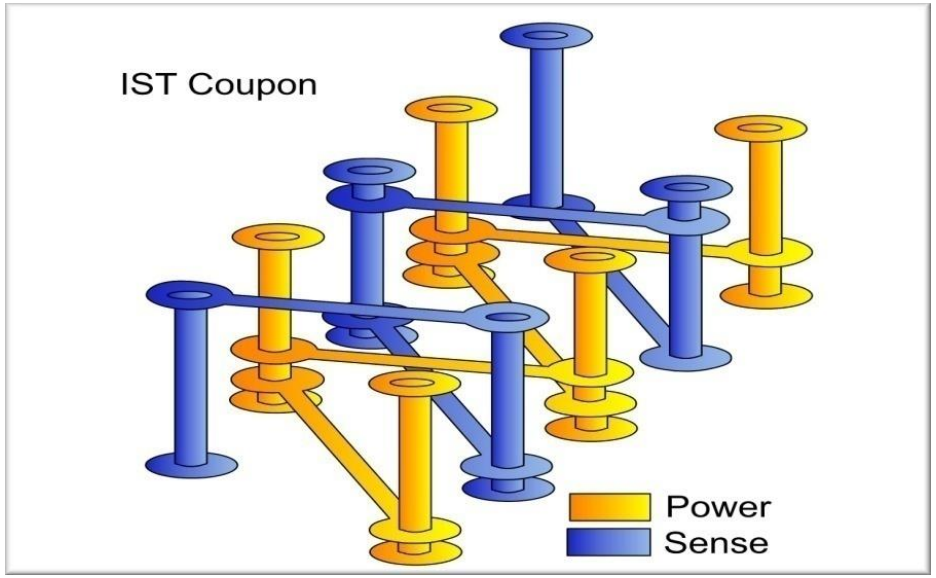
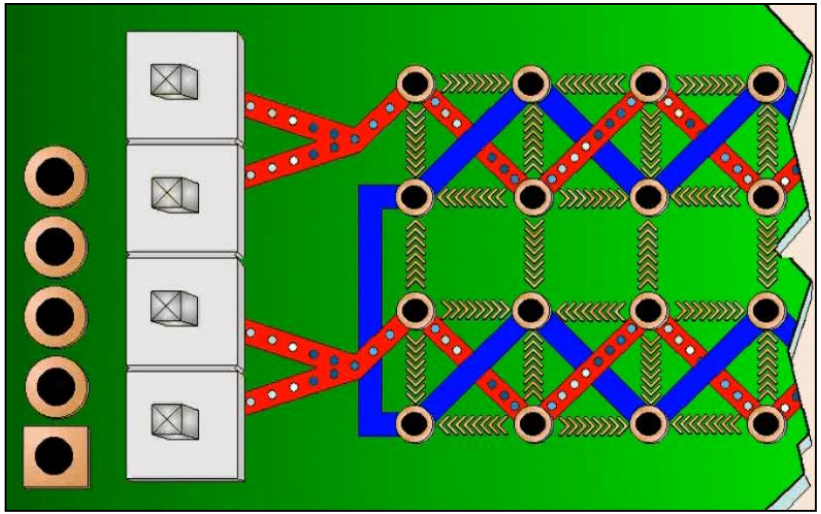
Polyimide	0.025
Cu	0.012
Adhesive	0.025
Polyimide	0.012
Cu	0.020
Adhesive	0.025
Polyimide	0.050
Cu	0.025
Soldermask	

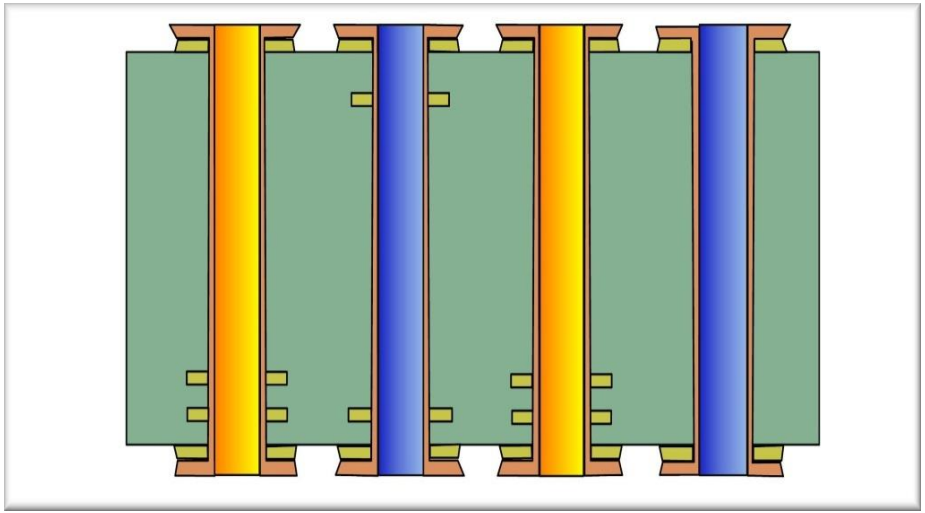
IST Coupon


Power Circuit
in Red
Sense Circuit
in Blue

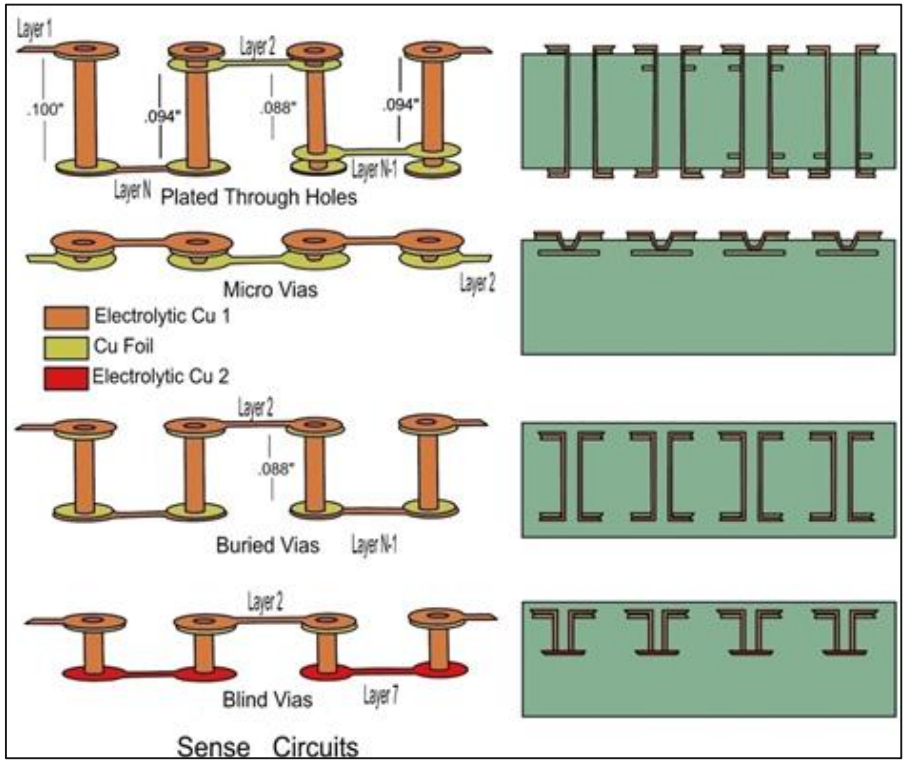

IST Coupon
Power
Sense

IST Coupon

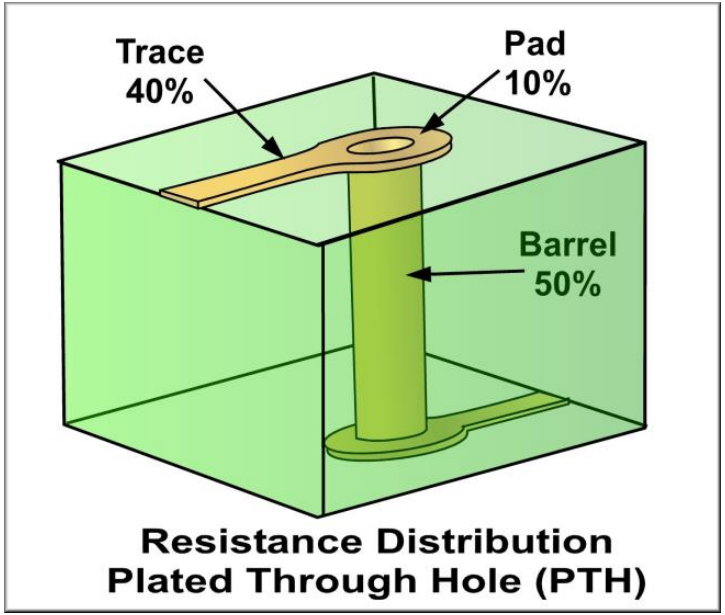


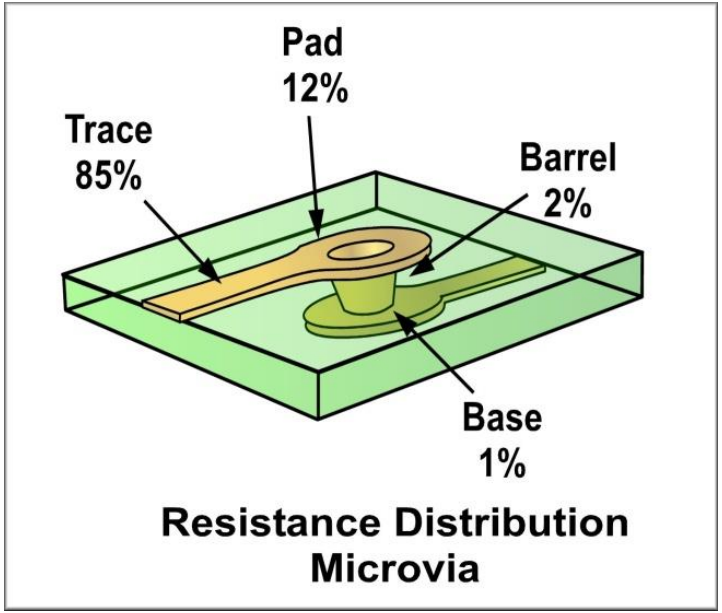


Messkreise im Coupon

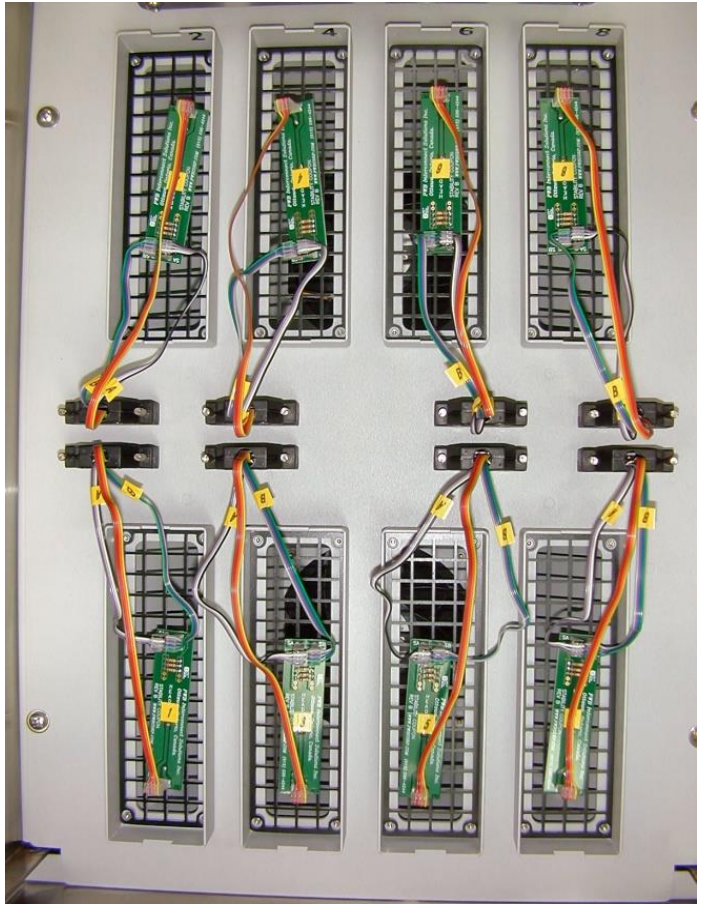


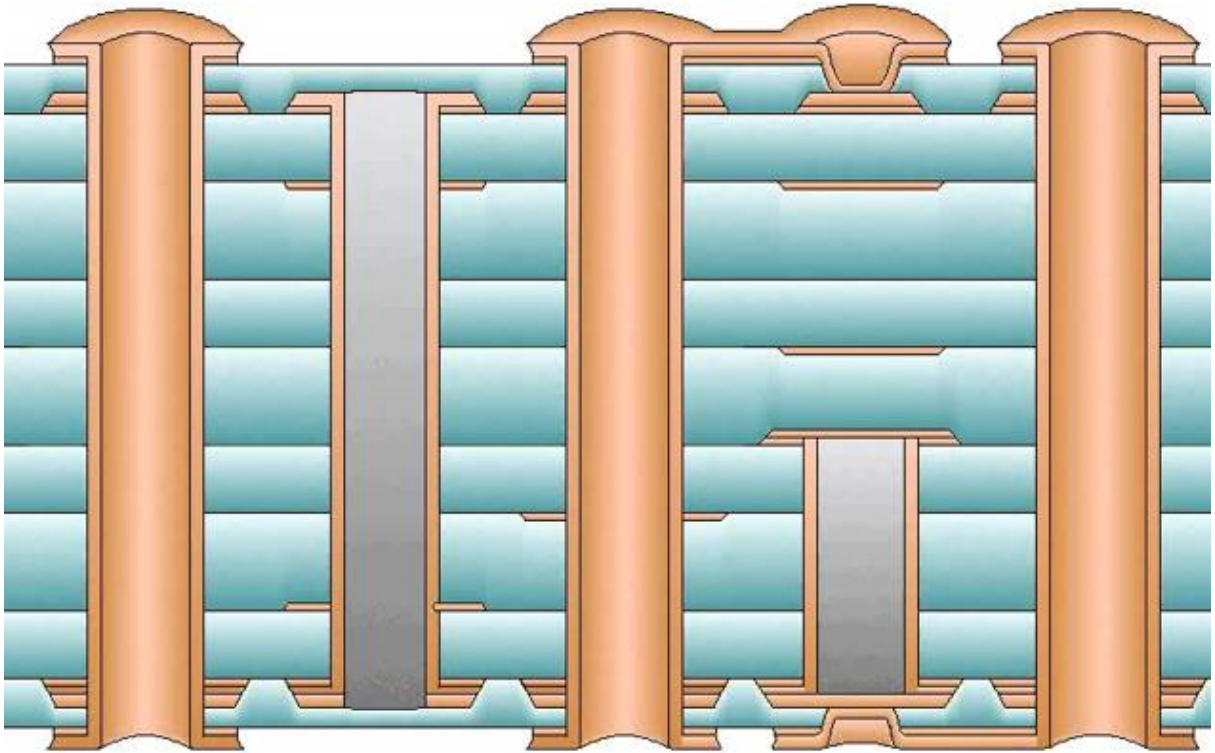
Coupon Design für optimale Widerstandsverteilung in der Daisy-Chain

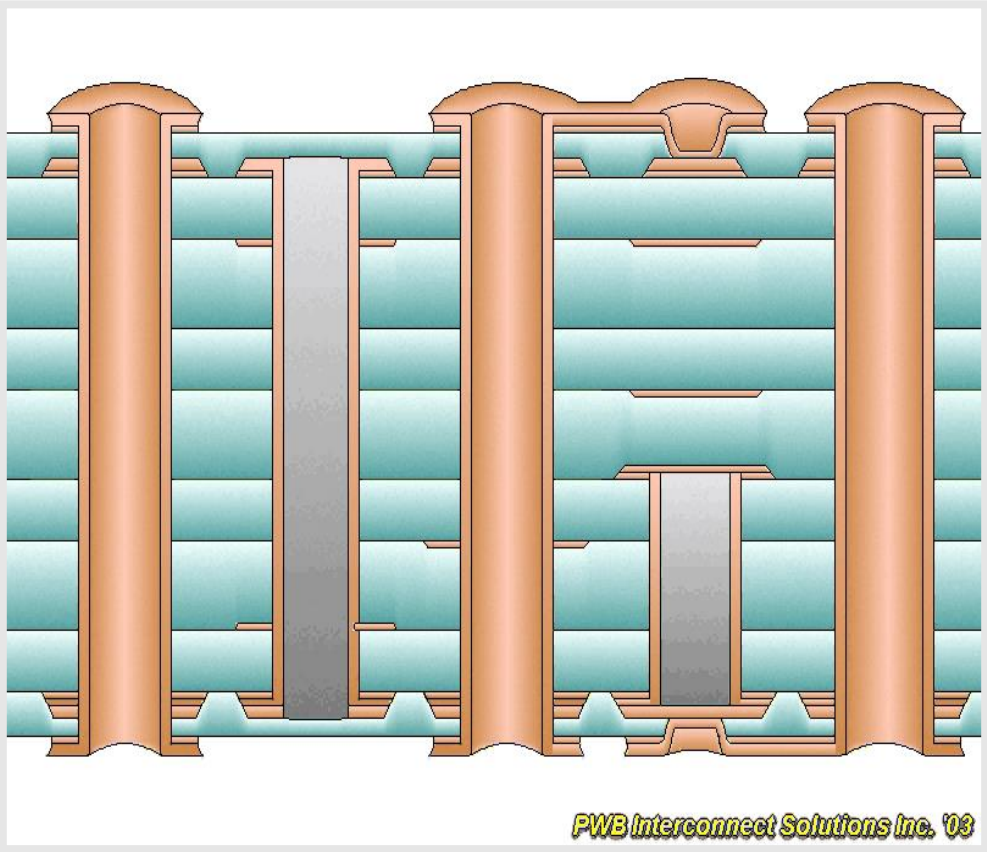




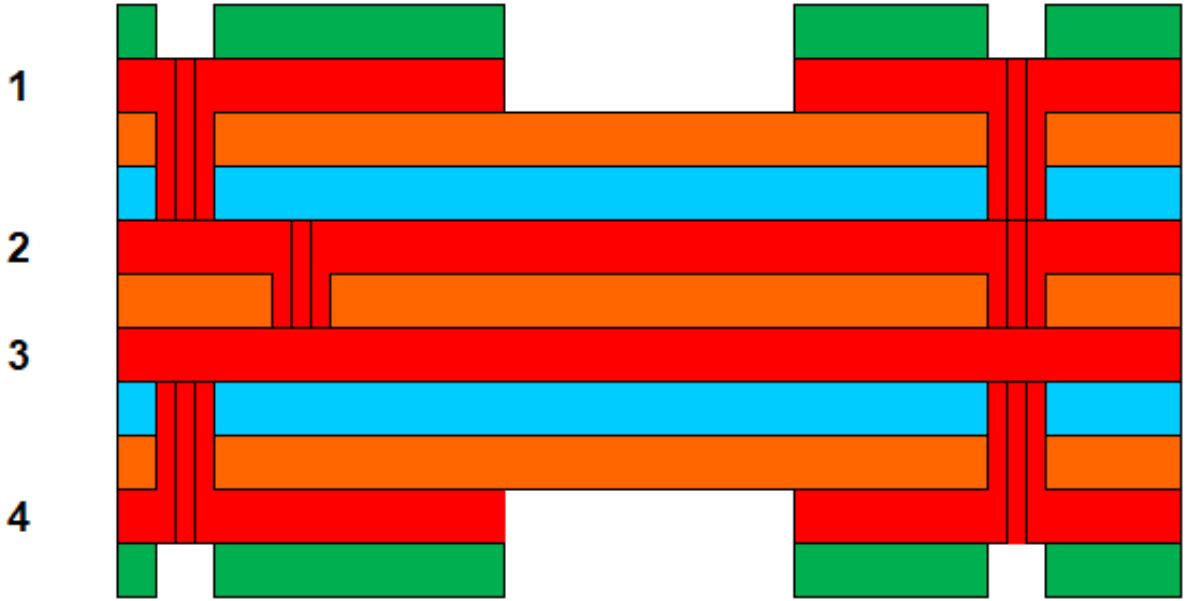
IST Tester






PWB Interconnect Solutions Inc. '03

4-Layer with stacked and staggered vias



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Adhesive	0.025
Copper	0.015
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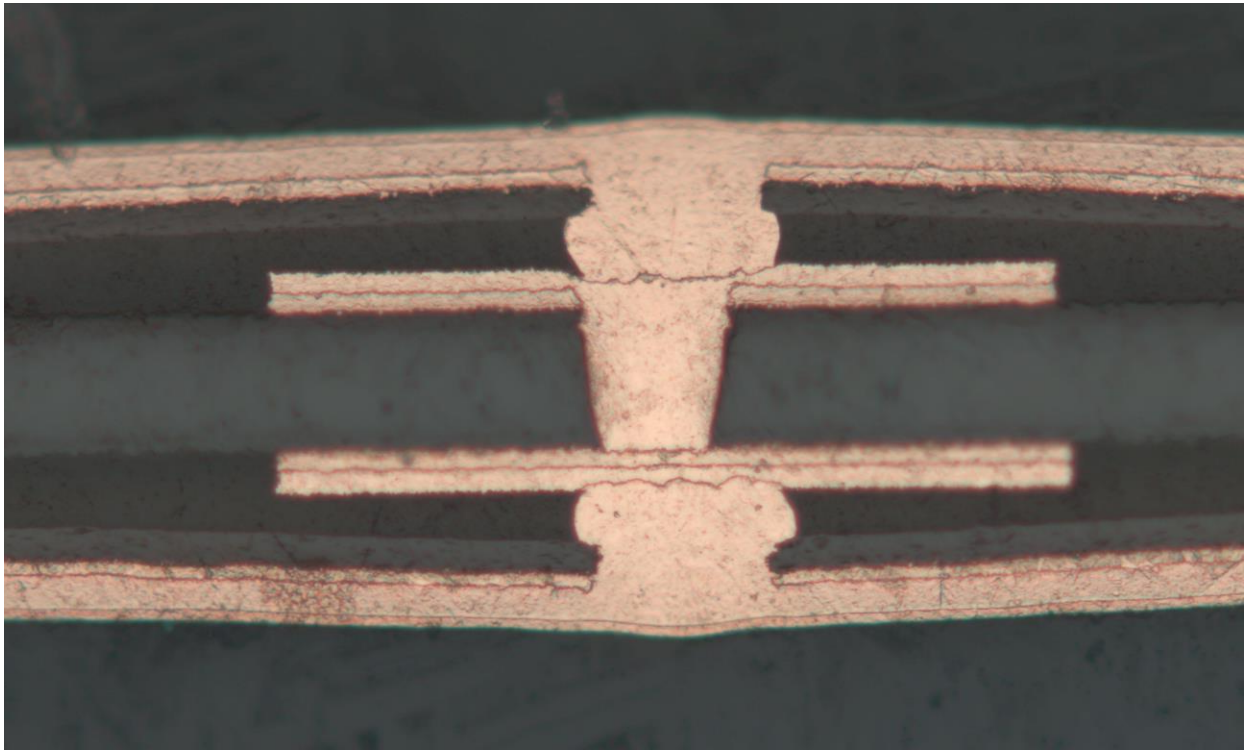
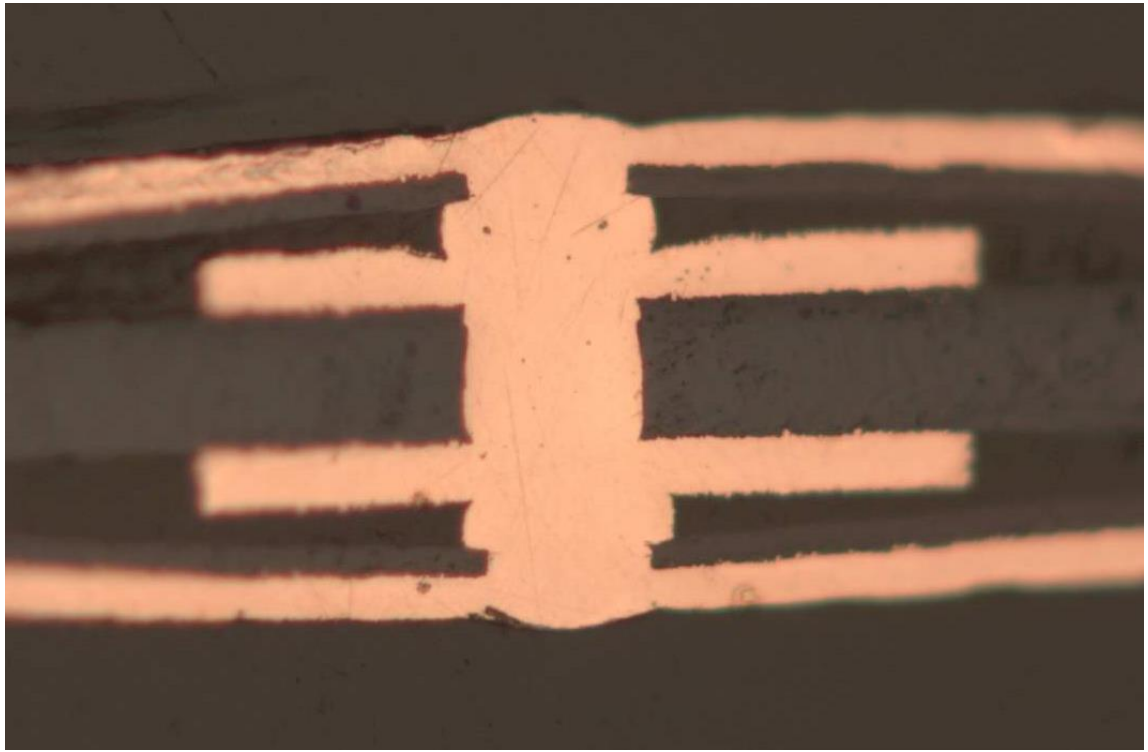
Polyimide	0.013
Copper	0.020
Soldermask	0.020

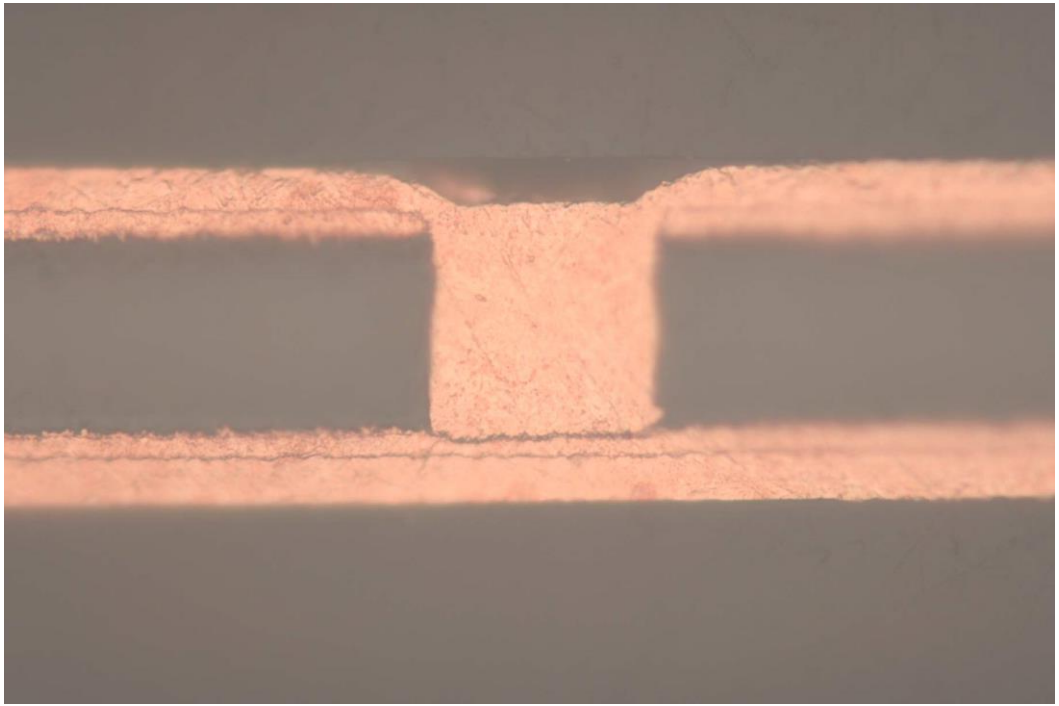
Cross Section 4-Layer with stacked vias (via in pad)



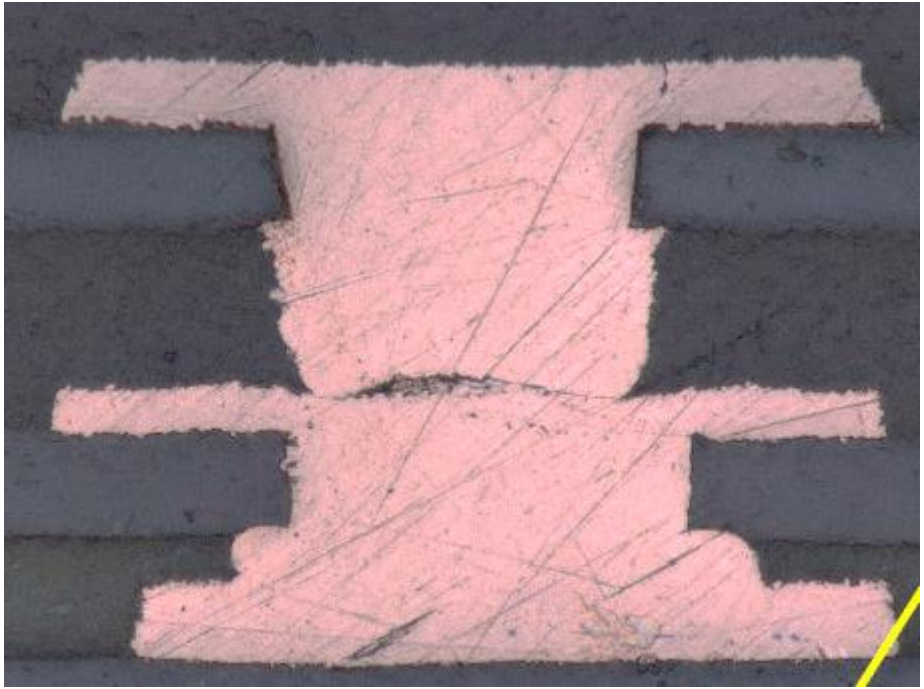
Cross Section 4-Layer with stacked vias (via in pad)

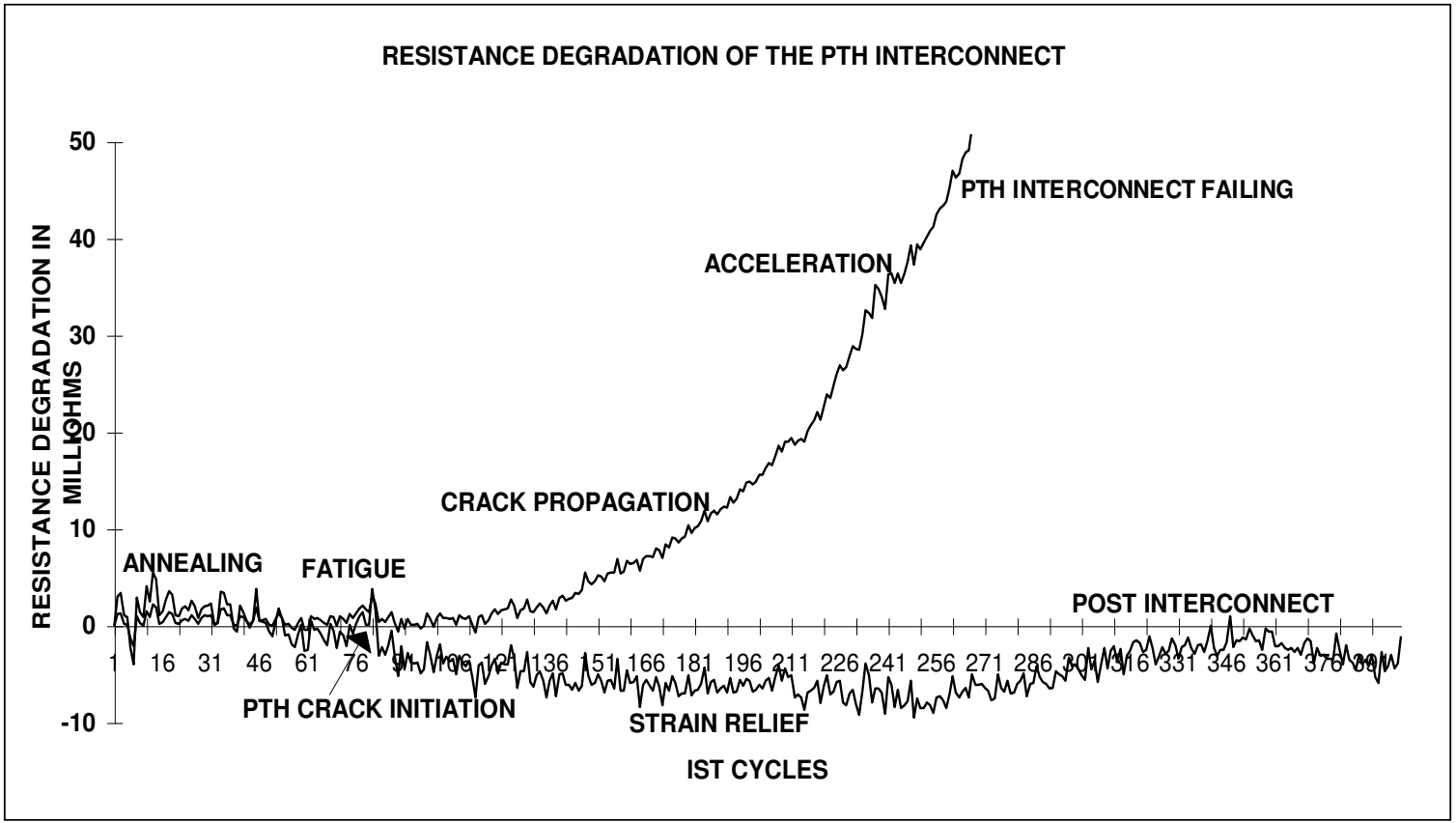


Cross Section

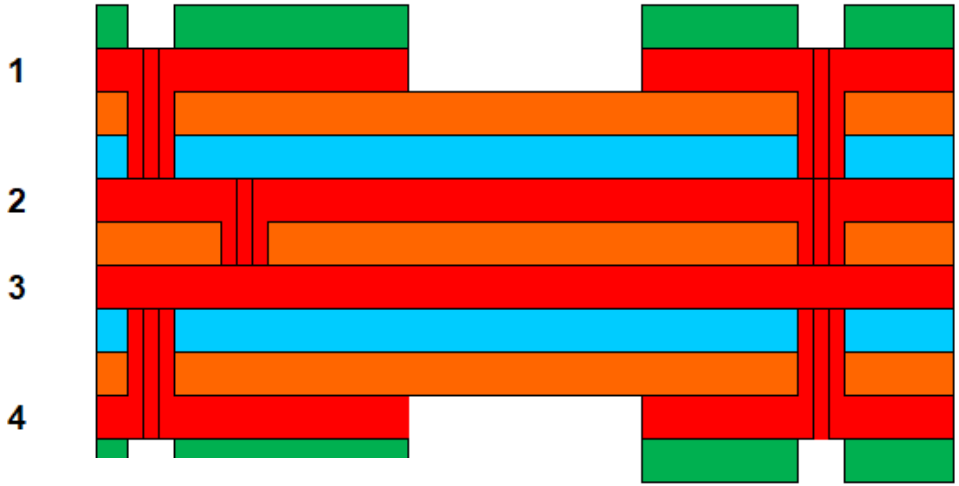


Cross Section – Fehlerbild (!)





Typisches Abbruchkriterium nach IPC: 10% Widerstandserhöhung



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Polyimide	0.013
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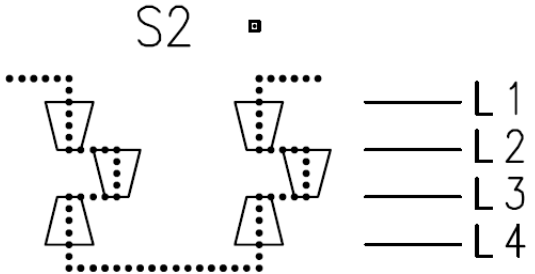
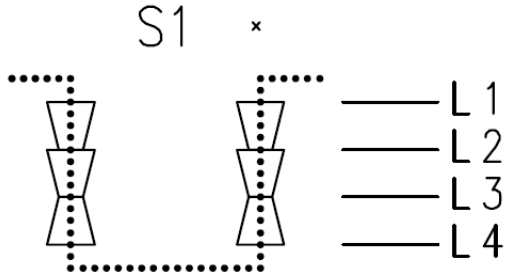
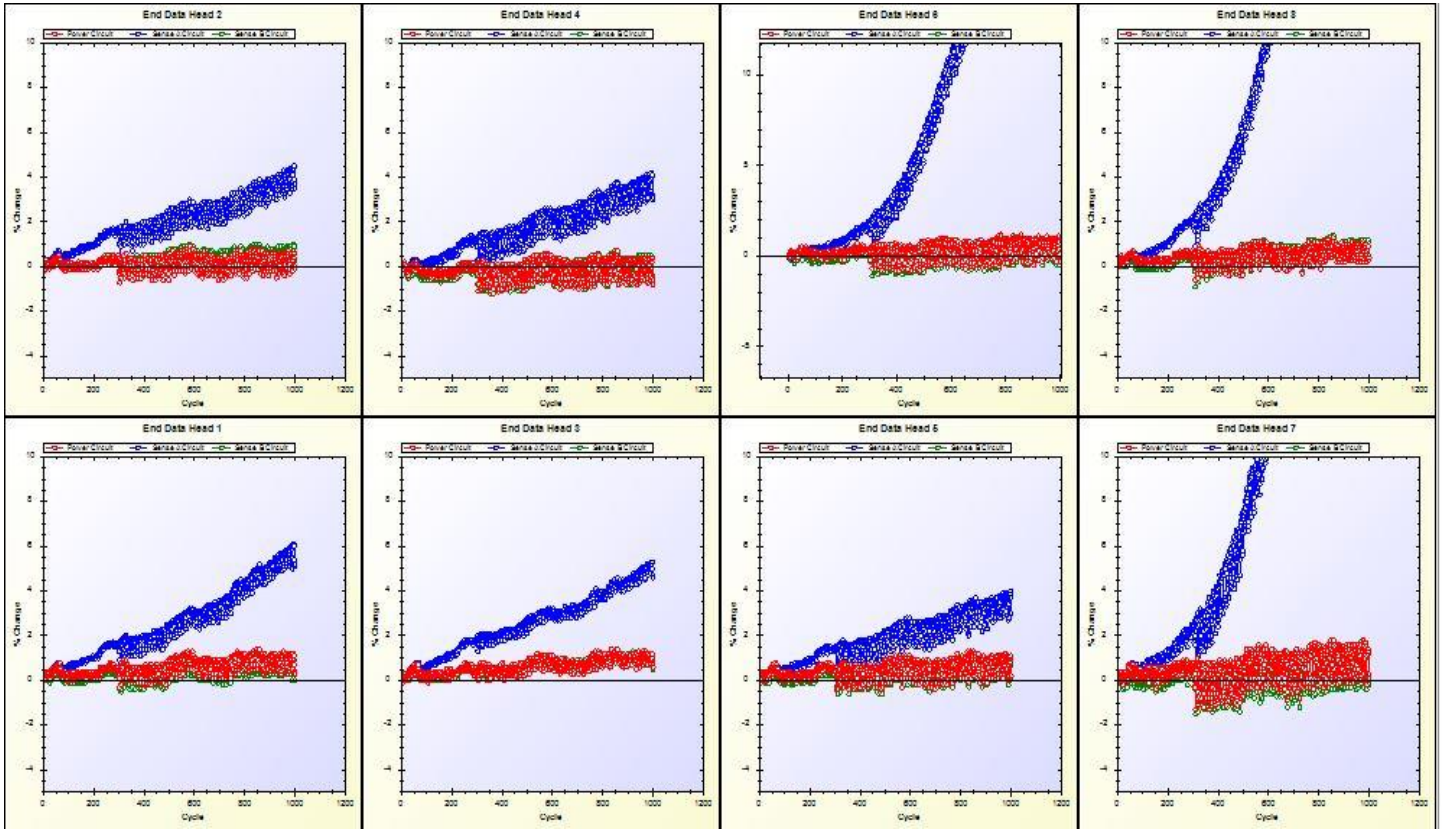
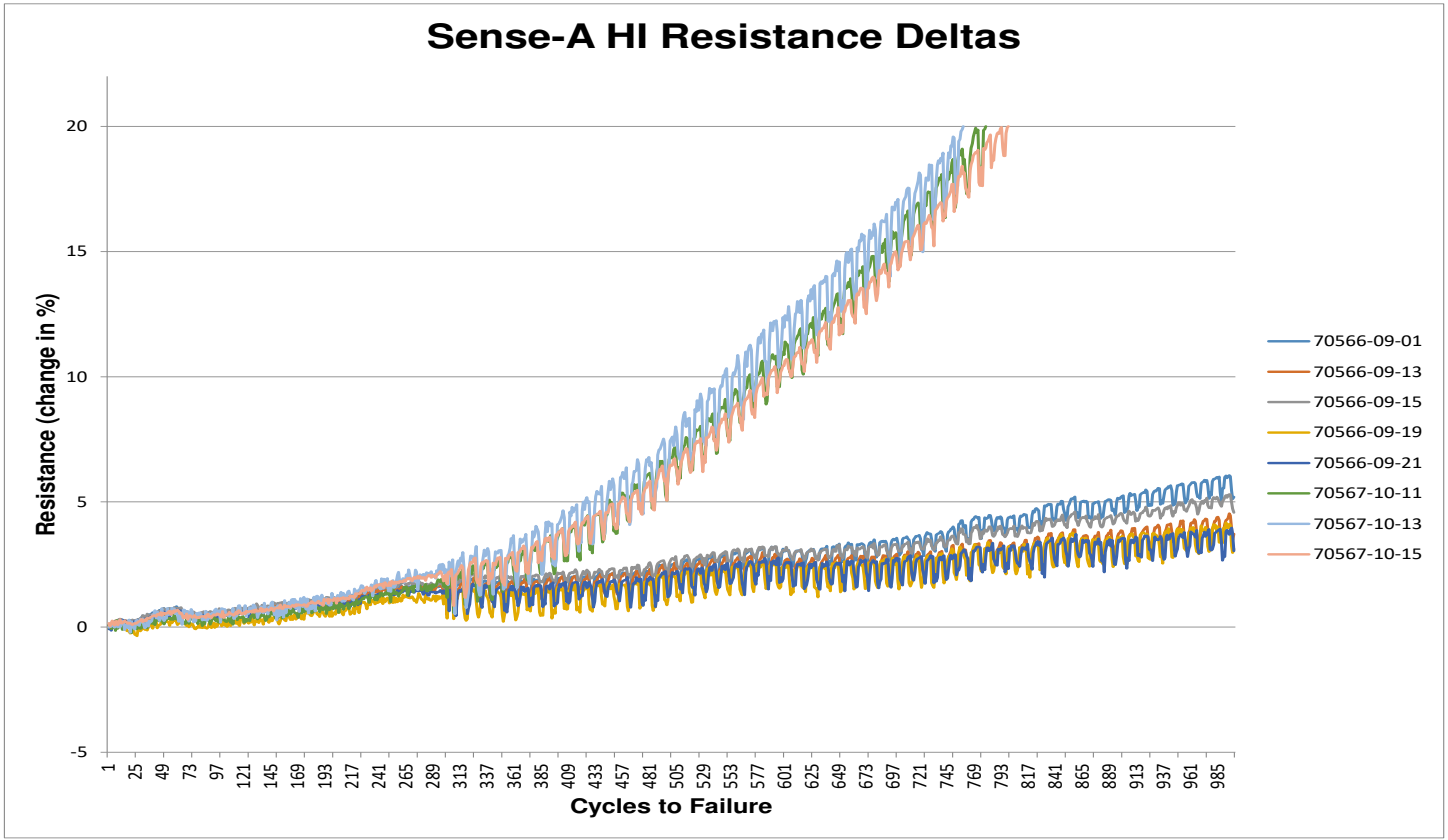
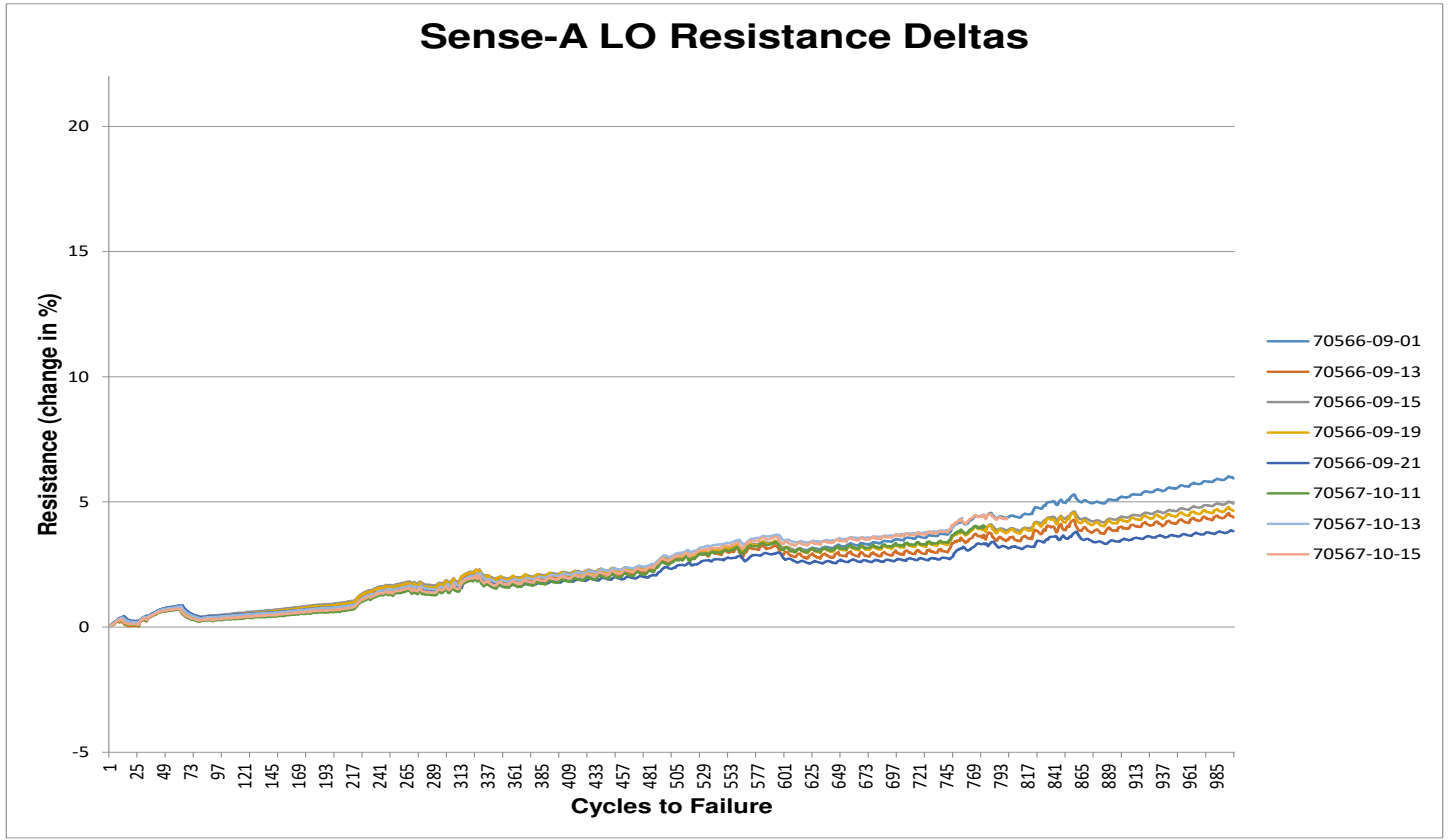
Polyimide	0.013
Copper	0.020
Soldermask	0.020

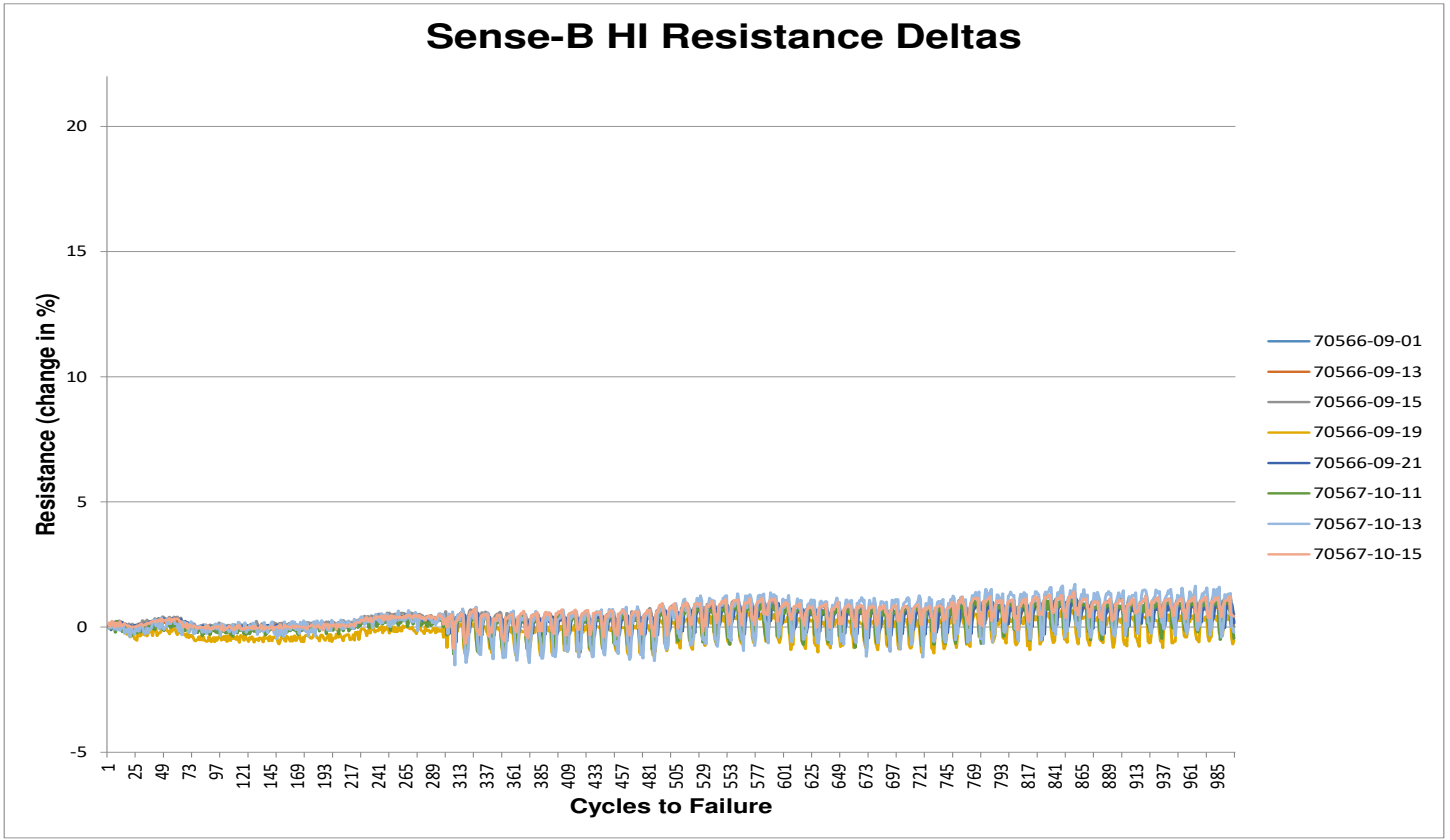


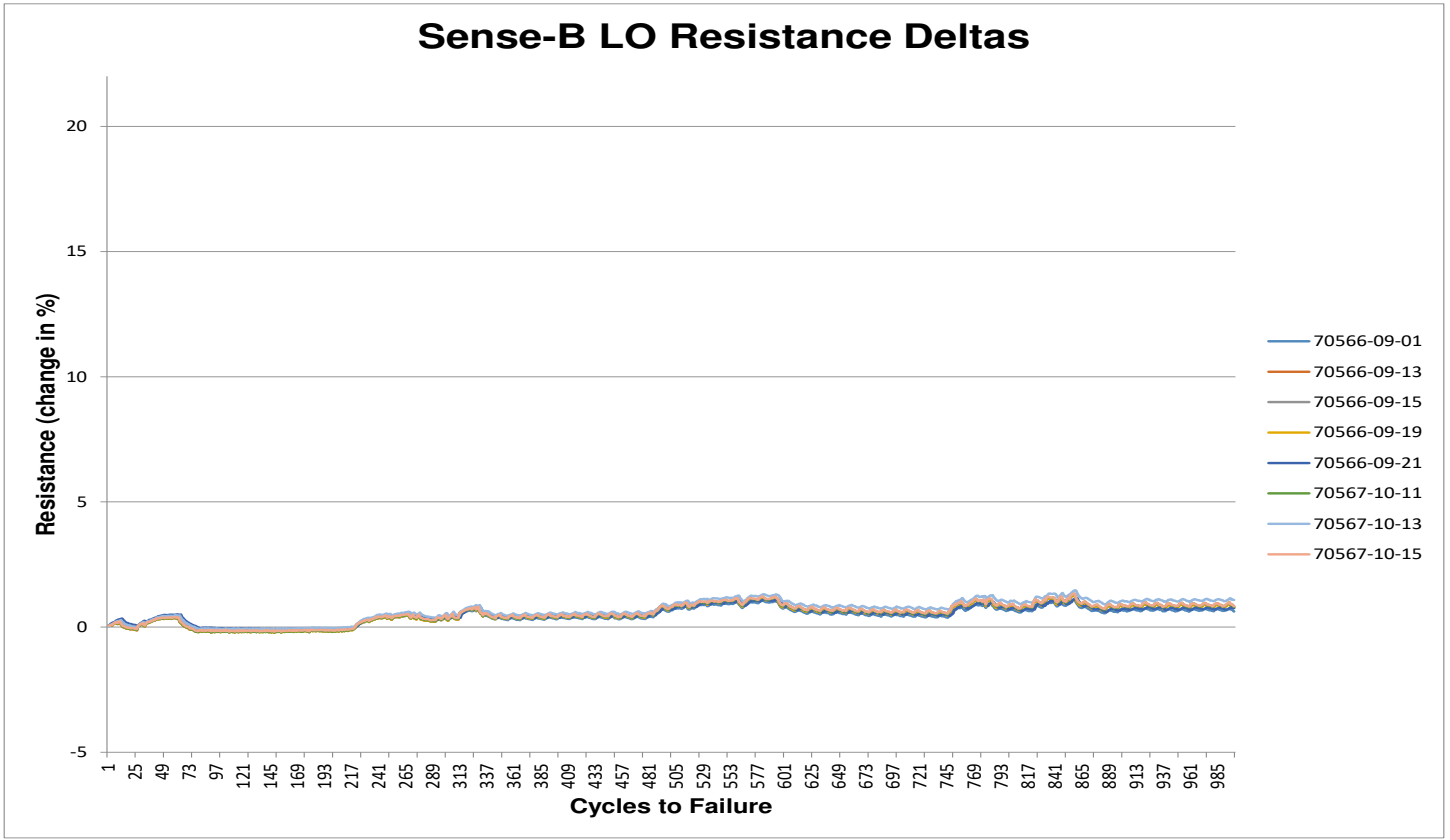


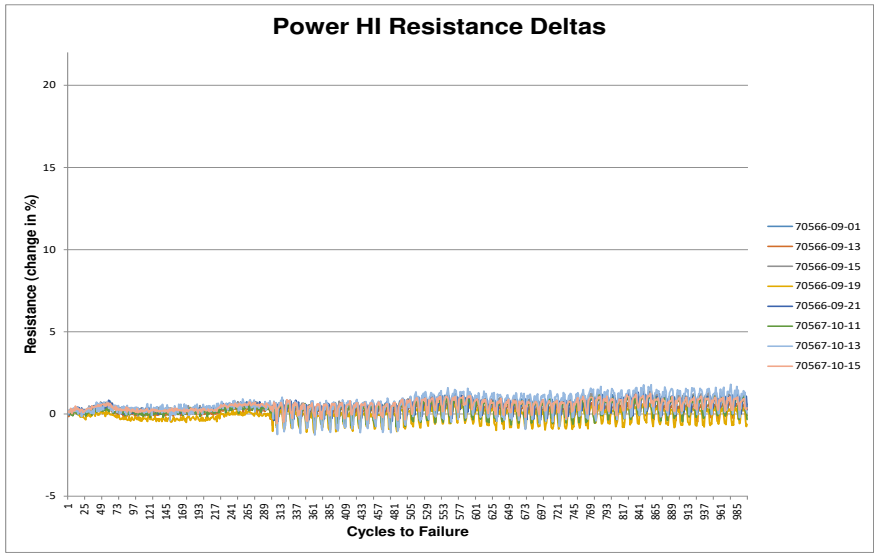

End Data Head 2
End Data Head 4
End Data Head 6
End Data Head 8
End Data Head 1
End Data Head 3
End Data Head 5
End Data Head 7
% Change
Cycle

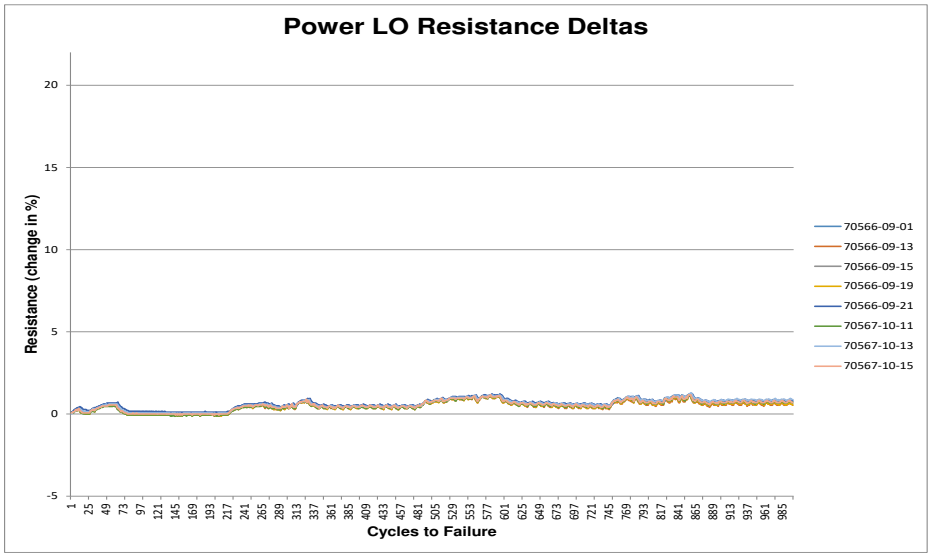

Sense-A HI Resistance Deltas
Resistance (change in %)
20
15
10
5
0
-5
1
25
49
73
97
121
145
169
193
217
241
265
289
313
337
361
385
409
433
457
481
505
529
553
577
601
625
649
673
697
721
745
769
793
817
841
865
889
913
937
961
985
Cycles to Failure
70566-09-01
70566-09-13
70566-09-15
70566-09-19
70566-09-21
70567-10-11
70567-10-13
70567-10-15


Sense-A LO Resistance Deltas
Resistance (change in %)
20
15
10
5
0
-5
1
25
49
73
97
121
145
169
193
217
241
265
289
313
337
361
385
409
433
457
481
505
529
553
577
601
625
649
673
697
721
745
769
793
817
841
865
889
913
937
961
985
Cycles to Failure
70566-09-01
70566-09-13
70566-09-15
70566-09-19
70566-09-21
70567-10-11
70567-10-13
70567-10-15


Sense-B HI Resistance Deltas
Resistance (change in %)
20
15
10
5
0
-5
1
25
49
73
97
121
145
169
193
217
241
265
289
313
337
361
385
409
433
457
481
505
529
553
577
601
625
649
673
697
721
745
769
793
817
841
865
889
913
937
961
985
Cycles to Failure
70566-09-01
70566-09-13
70566-09-15
70566-09-19
70566-09-21
70567-10-11
70567-10-13
70567-10-15


Sense-B LO Resistance Deltas
Resistance (change in %)
20
15
10
5
0
-5
1
25
49
73
97
121
145
169
193
217
241
265
289
313
337
361
385
409
433
457
481
505
529
553
577
601
625
649
673
697
721
745
769
793
817
841
865
889
913
937
961
985
Cycles to Failure
70566-09-01
70566-09-13
70566-09-15
70566-09-19
70566-09-21
70567-10-11
70567-10-13
70567-10-15


Power HI Resistance Deltas
Resistance (change in %)
20
15
10
5
0
-5
1
25
49
73
97
121
145
169
193
217
241
265
289
313
337
361
385
409
433
457
481
505
529
553
577
601
625
649
673
697
721
745
769
793
817
841
865
889
913
937
961
985
Cycles to Failure
70566-09-01
70566-09-13
70566-09-15
70566-09-19
70566-09-21
70567-10-11
70567-10-13
70567-10-15


Power LO Resistance Deltas
Resistance (change in %)
20
15
10
5
0
-5
1
25
49
73
97
121
145
169
193
217
241
265
289
313
337
361
385
409
433
457
481
505
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601
625
649
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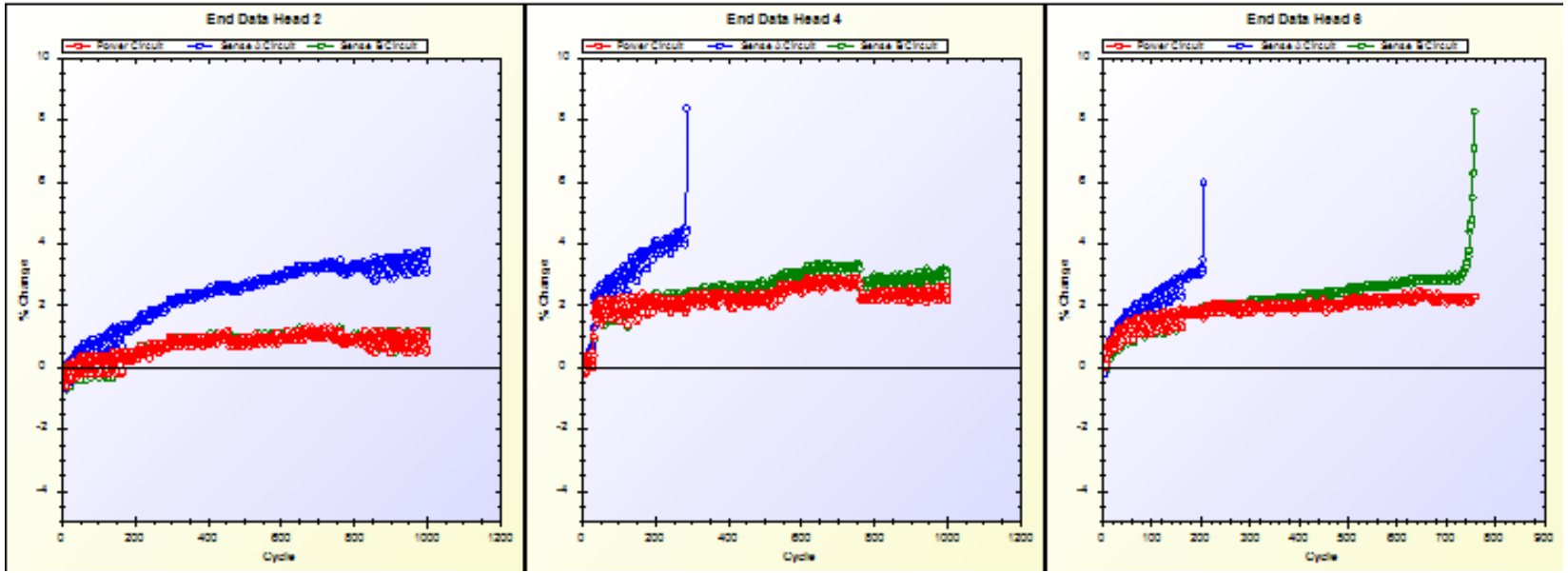
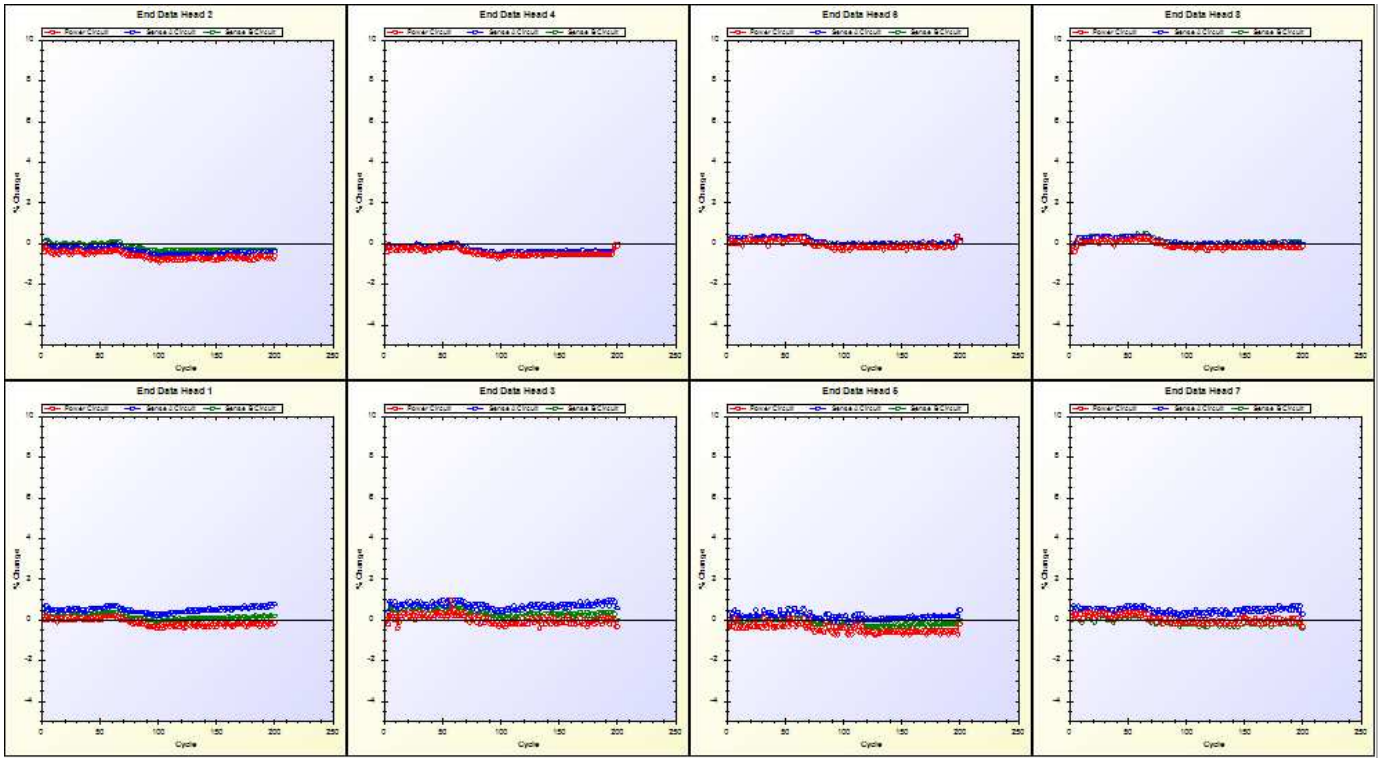
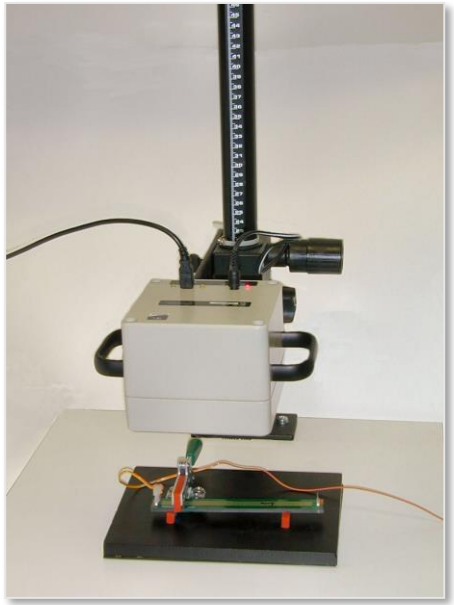
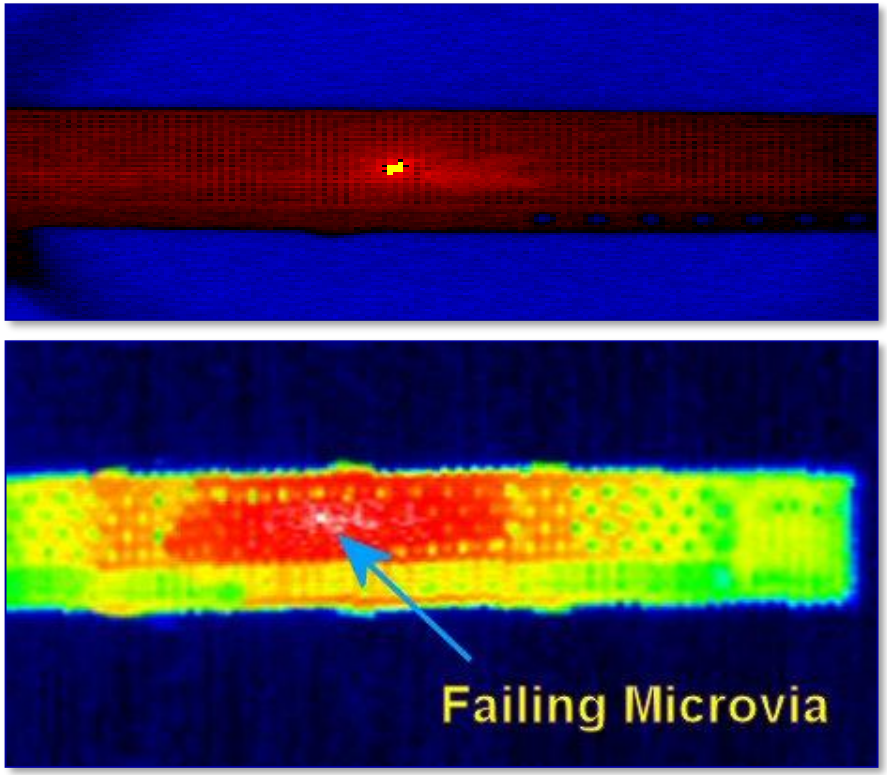
Cycles to Failure
70566-09-01
70566-09-13
70566-09-15
70566-09-19
70566-09-21
70567-10-11
70567-10-13
70567-10-15

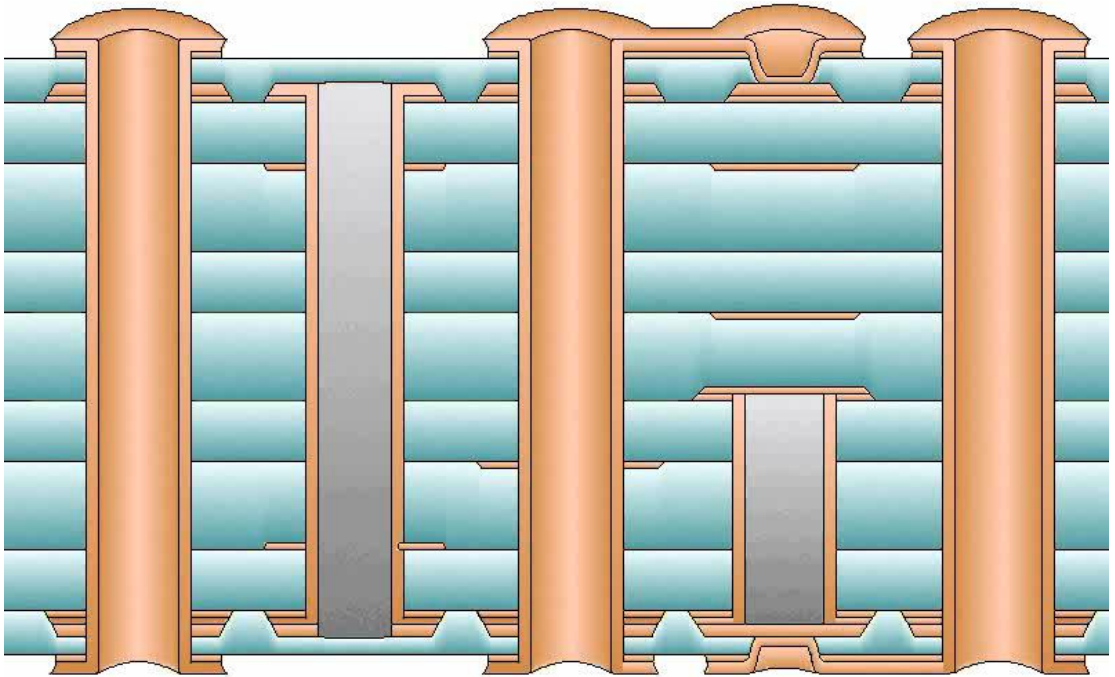

End Data Head 2
Power Circuit
Sense 3 Circuit
Sense 8 Circuit
% Change
Cycle
End Data Head 4
Power Circuit
Sense 3 Circuit
Sense 8 Circuit
% Change
Cycle
End Data Head 6
Power Circuit
Sense 3 Circuit
Sense 8 Circuit
% Change
Cycle

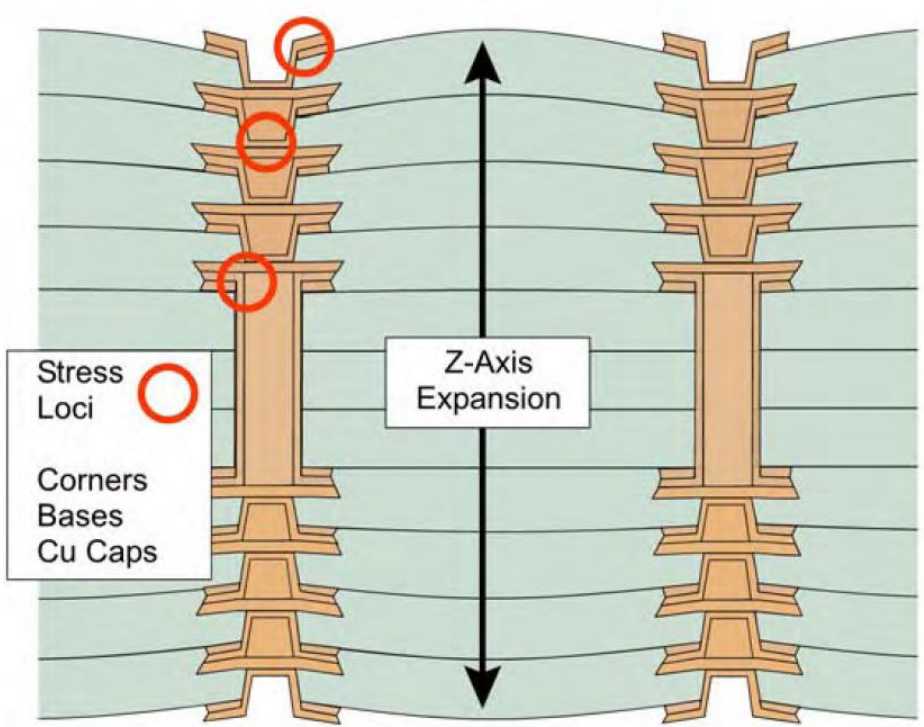

End Data Head 2
End Data Head 4
End Data Head 6
End Data Head 8
End Data Head 1
End Data Head 3
End Data Head 5
End Data Head 7
Power Circuit
Sense 1 Circuit
Sense 8 Circuit
% Change
Cycle

Fehlerlokalisierung Infrarot

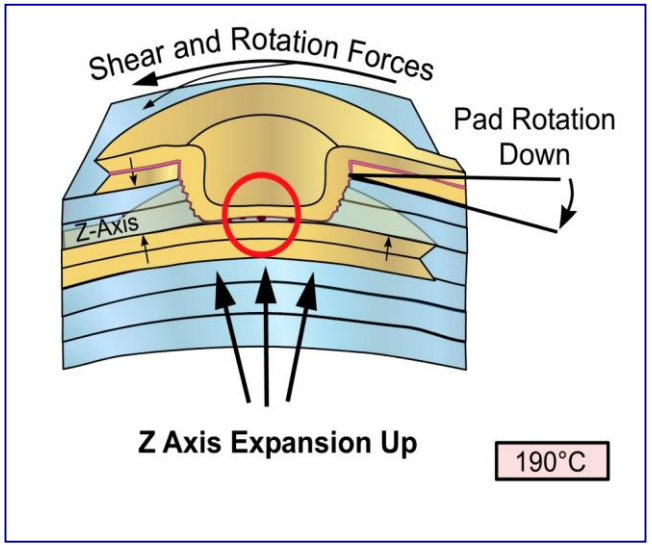


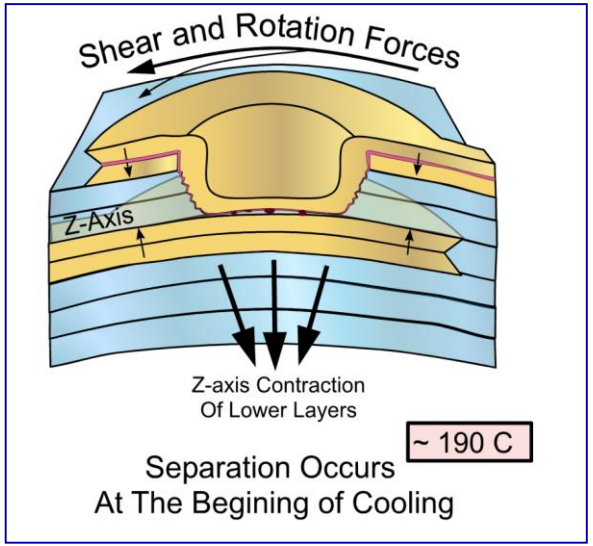





Stress
Loci
Corners
Bases
Cu Caps
Z-Axis
Expansion

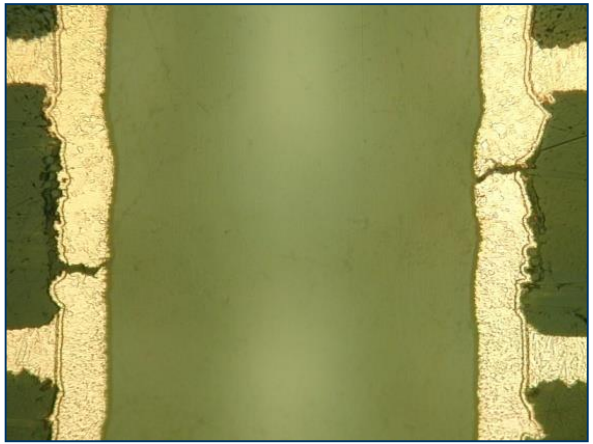
Microvia Targetpad Abriss

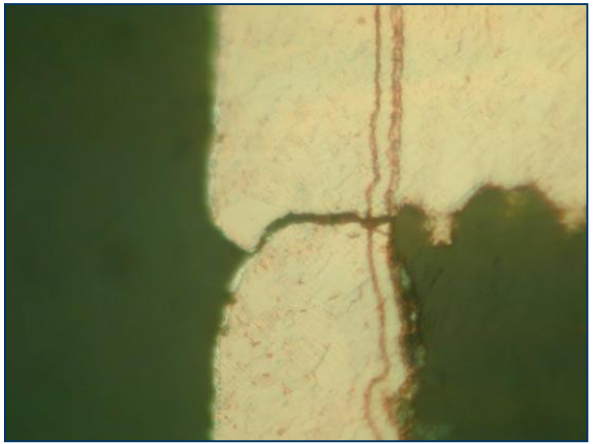


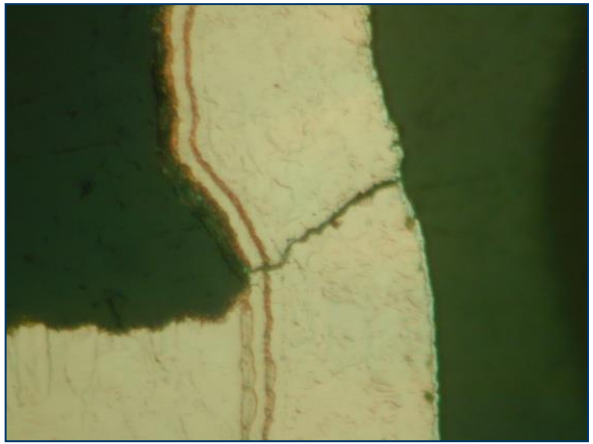


Abriss entsteht erst bei der Abkühlung(!)

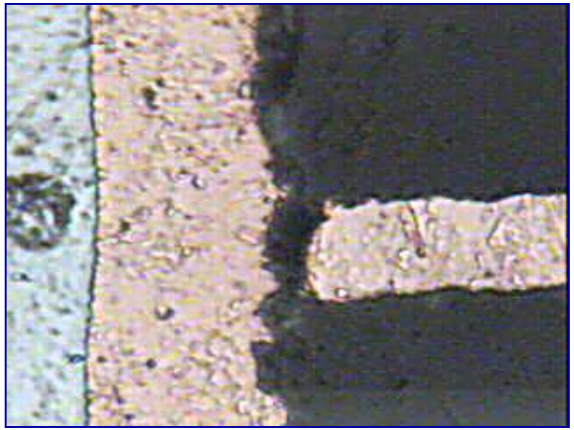
Fehlerbilder

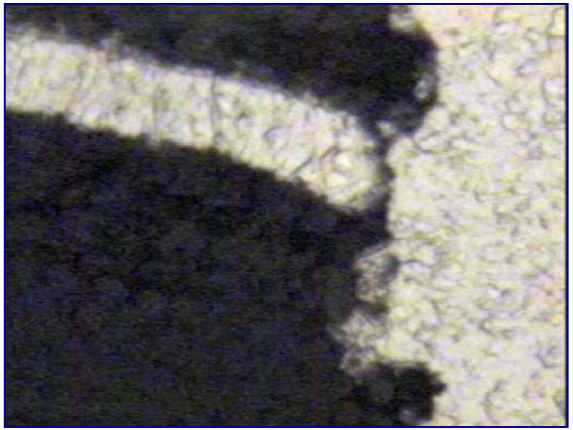


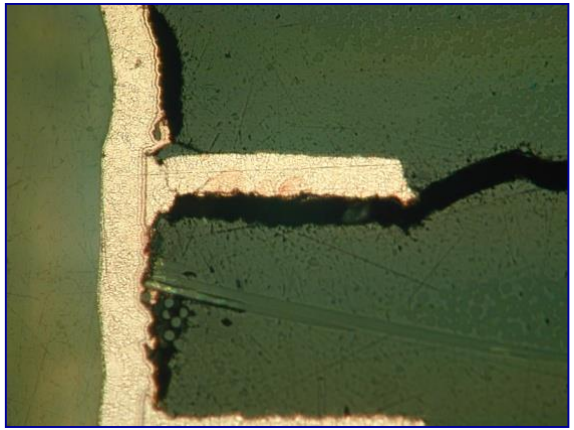




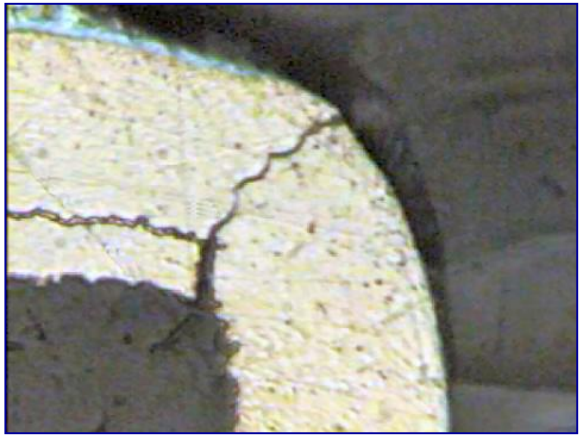
Fehlerbilder

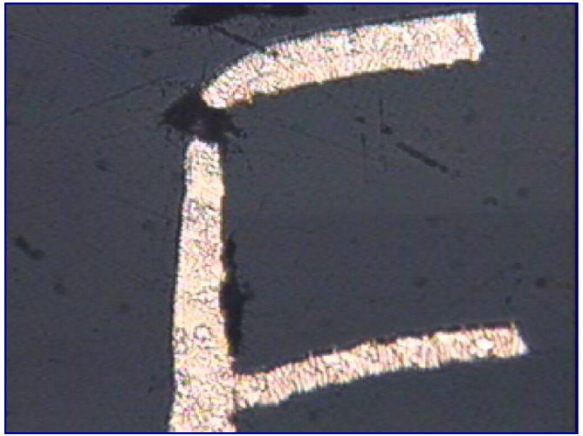




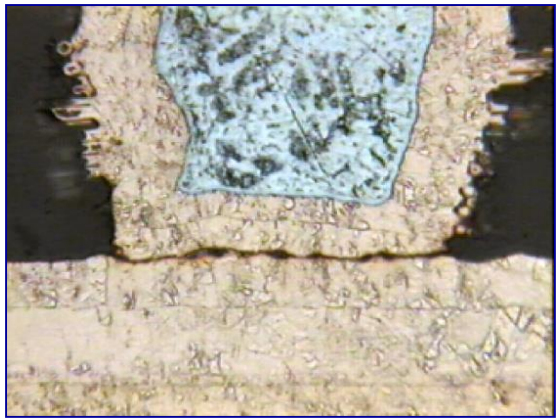


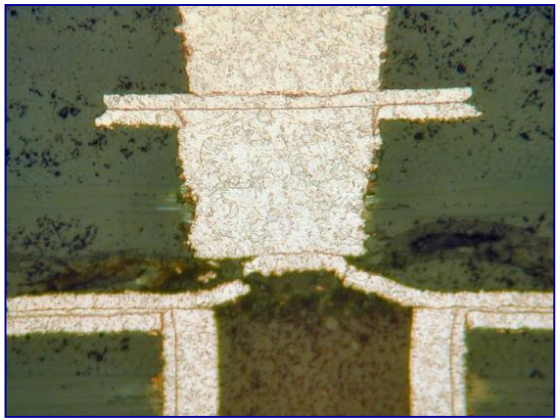
Fehlerbilder





Fehlerbilder





Low CTE / thin rigid materials examples

- BT Laminates (Mitsubishi, HL832NSF LCA)
  - Very thin (starting with 15µm Laminate, 3µm Cu)
  - Low CTE (3/19)
  - High Tg (300°C)
  - Low Dk/Df (3.9 / 0.006)
  - High modulus
  - High stiffness
- Epoxy based, halogen free (Hitachi MCL-E-700)
  - 30µm Prepreg
  - Halogen free

Einflussgrössen auf Zyklenfestigkeit

- Temperatur
- Bohrdurchmesser
- Leiterplattendicke
- Ausdehungskoeffizient des Dielektrikums
- Kupferschichtdicke in der Hülse
- Abstand der Bohrungen - Raster

Quality Management System

- ISO 9001:2015 and ISO 14001:2015
- EKAS safety requirements (since 2001)
- IPC-A-600 Certified IPC Trainer CIT
- IPC-A-600 Certified IPC Specialists CIS
- UL certified, E96683
- Not certified, but compliant to:
  ISO 13485, TS 16949, AS 9100, MIL-, ECSS-, AQAP-,
  JEDEC-Standards

Member

Fachverband für Design,
Leiterplatten- & Elektronikfertigung

SWISS MEDTECH
Member

Metrology and reliability laboratory

- Automatic optical X,Y,Z measurement system, ±5µm
- Manual optical X,Y measurement system, ±20µm
- Measurement microscopes (X,Y,Z), ±2µm
- 3D Topography measurement system, ±0.5µm
- Microsection measurement microscope, ±1µm
- IST - Interconnection Stress Test (2016 & 2019 & 2022)
- Delamination Test System (2016)
- Metallographic section analysis
- Reflow Simulation
- Contamination measurement
- Thermal stress/shock test
- Thermography

Inhouse testing capabilities

- X-Ray Fluorescence (XRF) SDD-Detector, limit. 2-5nm thickness
- Impedance Control (Polar)
- Hi-potential testing
- Peel-Strength measurement system
- Temperature Cycle Test (TCT)
- …

Investments for better technology and troughput

- New Schmoll laser (2022) & additional IST - Interconnection Stress Test (2022)
- New x-ray drilling machine (2022)
- New milling machines (2021) & new Plasma treatment (2021)
- New ESI laser – micro via laser (2020) & New Rivolino – rivet bonding (2020)
- New Ledia – direct Imaging (2019) & Additional AOI (2019)
- New in-house surface finish ISIG (2019)
- Microfill in-house (2019)
- Additional in-house IST – Interconnection Stress Test (2019)
- New in-house hole filling machine – epoxy (2018)
- Additional electrical test (2018)
- New milling machines (2017 & 2018 & 2019)

PWB interconnect solutions inc. IST testing systems and services

Polar Instruments

Optiprint
Innovative PCB Solutions

Roadmap

Properties	2020	2022 Serial production	2022 R&D	2023	2025	2030
Project Line/Space [µm]	25/25	**25/25**	20/20	15/15	10/10	5/5
Etching tolerance [µm]	±8	**±8**	±5	±4	±4	±2
Layer/Layer tolerances [µm]	±20	**±20**	±20	±15	±15	±6
Min. Annular ring [µm] DL/ML	50/75	**38/50**	38/50	30/50	30/50	15/25
Soldermask Position [µm]	±30	**±25**	±25	±20	±20	±16
Milling/Layer tolerance [µm]	±40	**±35**	±35	±35	±35	±35
Min. Hole Size [µm] Laser/Mechanical	50/76	**25/50**	25/50	20/50	20/50	20/50
Min. Material thickness [µm] Flex/Rigid	12.5/50	**12.5/35**	8/-	8/-	5/-	4/-
Min. Copper Thickness [µm]	3	**3**	2	1	1	1
Degree of Automation	75 %	**85 %**	90 %	93 %	95 %	95 %

General design rules

Properties	Standard	Optimized	R&D
Copper Pattern Line/Space [µm]	75/75	50/50	35/35 (25/25)
Min. Annular ring [µm]	100	50	38
Min. Hole Size [µm] Laser/Mechanical	80/100	50/100	25/75
Pattern to Via Position / Soldermask to Pattern Position [µm]	±100	±50	±38
Outline/Pattern tolerance [µm]	±100	±50	±35
Min. Pitch [µm]	355/375	200/250	135/185

General Guideline. Please confirm your specific design rules for your product with our experts

Why Optiprint ?

- Products 100% made in Switzerland
- Customized solutions
- An organization at your service
- High quality and reliability
- Competence and knowledge
- From single pieces to mass production
- Top certifications
- Top customer support

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